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ANATOMICAL OBSERVATIONS ON THE BRAIN AND SEVERAL SENSE-ORGANS OF THE BLIND DEAF-MUTE, LAURA DEWEY BRIDGMAN.

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I.

Through the exertions of President G. Stanley Hall, the brain in question was obtained and was put by him in my hands for description. Several gentlemen whose names will duly appear have assisted by describing the sense-organs. I am under obligation to others for facilitating the work in many ways, and especially to Prof. W. F. Whitney and his colleagues of the Harvard Medical School, Prof. B. G. Wilder of Cornell University, and Prof. C. K. Mills of the University of Pennsylvania, for the privilege of examining specimens in their possession. For the opportunity to consult the literature I am indebted to the exceptional facilities offered by the Library of the Surgeon General at Washington of which I have made much use.

In the study of this case it has been my aim to give as full a description as the material in my hands would warrant, and for this purpose I have applied a large number of tests to the brain, to determine, if possible, whether the peculiar mental existence of Laura Bridgman, which was the result of

her defective sense-organs, has left any trace on her brain, or whether such anomalies as may be observed are sufficiently explained when considered as the direct consequences of the initial defect alone. This is, therefore, a special study in the general field of the inter-relation of brain structure and intelligence. What might be expected to come from the various tests will be discussed under the separate headings, and I shall leave such generalizations as are possible until the special points have been set forth.

Biographical Notes.

By way of introduction, I may be permitted to state some biographical facts that will bear on this discussion. Laura Dewey Bridgman(1)* was born Dec. 21, 1829, in Hanover, New Hampshire, U. S. A. She was the child of Daniel and Harmony Bridgman, who were farming people. The parents(1) are described as of sound health, good habits, average height, slenderly built; the father with a small head, the mother with "not a large head"; both rather nervous; the mother active-minded. Their culture was such as might be found in rural districts like their own at that time. Laura inherited the physical peculiarities of her mother, and her health was delicate. During infancy she was subject to convulsions, but at the age of twenty months her health improved, and she is described as active and intelligent. She had learned to speak several words, and knew one or two of the letters of the alphabet, when, being two years(2) † old, she and her two older sisters, forming at that time the family, were attacked with scarlet fever. The two sisters died. Laura was severely ill; both eyes and both ears suppurated, and taste and smell were impaired. Sight in the left eye was entirely abolished. With the right eye she appeared to get some sensation from extremely large bright objects, up to her eighth year, but after

* The bracketed figures in the text refer to similar figures in the bibliography, where the authority is given in full. In some cases reference is made to the page of the publication cited and this is then bracketed in the text with the figures just mentioned.

† The date of this illness is a matter of some importance. As there is no agreement among the various authors on this point, I have been forced to choose an authority and have naturally taken the dates given by Dr. Howe in his Reports.

that time became completely blind. Two years passed before she recovered sufficiently to sit up all day. At the age of five years she had regained her strength. Speech was lost with the loss of hearing, and when her education at home was renewed, it was by means of arbitrary tactual signs of the simplest sort. She was taught to sew, to knit and to braid, and to perform some minor household duties. On Oct. 4th, 1837, she was brought to the Perkins Institution and Massachusetts Asylum for the Blind, and her education was begun by Dr. S. G. Howe, then director of the institution. She was now seven years and ten months of age, and in the defective condition above described. Dr. Howe ([2—p. 161]) says of her at this time: "figure well formed; nervous sanguine temperament; a large [no measurements have been preserved] and beautifully shaped head, and the whole system in healthy action."

The process of education commenced with the pasting of the name of a common object on the object, the name being in raised letters, such as are used for the blind; then the association of the name and object; then forming the name from the individual letters; and after a long time the letters themselves were learned. It was when she first recognized that the sign for an object could be constructed from the individual letters, that the meaning of what she was doing dawned upon her. From that time on her education became easier, and, indeed, she had in one sense to be held back in her work, as there was danger that her frail constitution would succumb to the too great interest in her studies. It is important to note that at this time she exhibited the various emotions by gesture and facial expression. She was fond of dress and pleased by attention. The lapse of time within the limits of the day and the occurrence of Sunday were correctly noted by her. In the report for 1839 ([2—p. 177]) it is said that she can distinguish between a whole and half note of music, and will strike the notes on the piano quite correctly. (How this interesting test was made, is not quite clear.) A test of her sense of taste at this time showed her capable of distinguishing better between different degrees of acidity than between this and sweetness or bitterness. She appeared at the same time to care rather less for eating than most children of her age.

The sense of smell seems to have been subject to some variations. During the first years of her residence at the institution it was apparently completely wanting, and there was never at any time the slightest tendency to test objects by holding them to the nose. Later (1843) she seemed able to locate the kitchen by the odors coming from it, but this sense does not appear to have ever been of any importance to her. The sense of touch was very acute even for a blind person, and she was sensitive to jar.

Dirt or a rent in her clothing caused her shame. She was familiar with those of her own sex, but distant to men, and was remarkable for her sense of order, neatness and propriety. She seemed capable of discovering the intellectual capacity of those with whom she was thrown, and quickly chose the more intelligent for her companions. Occasionally, too much attention to other scholars, in her presence, aroused jealousy on her part.

She cried only from grief, and the pain from a bodily injury she sought to annul by jumping and excessive muscular motions. So far as could be learned, she did not dream in the terms of her lost senses, and this is what might be expected, since they were lost at so early an age(3).

She made a number of noises. Francis Lieber studied these with some care, with a view to their bearing on the origin of language(4). It appears that Laura had some fifty or more sounds by which she was accustomed to designate people whom she knew. They were all monosyllabic. Besides this she laughed much and loud, was noisy at play, and occasionally made other emotional noises which were suppressed by her teachers. In this respect she was similar to most mutes, so-called, who appear to have a variety of sounds at their command.

In a recent article, Mrs. Lamson(5) states that Laura once uttered the word *doctor* by accident, and her attention being called to this, she subsequently always spoke the word instead of spelling it with her fingers. The same thing happened with the words *pie*, *ship* and several others. These facts are taken to indicate that though so defective, she might possibly have been taught to vocalize, as has been done in some more recent cases. She appeared to keep constantly her

relations in space, and became confused if she lost what might be called "the points of the compass." She was much afraid of animals, and when more than fifteen years of age could hardly be induced to touch a docile house-dog.

When about sixteen she is described as more thoughtful and sedate, though cheerful—a condition which Dr. Howe regards as showing that her age was to be measured by the degree of her mental development rather than by the number of years she had lived. When she was twenty years of age her regular education ceased, and the special reports by Dr. Howe stop at this time.

In 1878, President G. Stanley Hall([6]) made a valuable series of tests upon her. At this time she was found completely blind and deaf, though the sense of jar was well enough developed to enable her to recognize the footsteps and sometimes even the voices of her acquaintances, her common statement being that she heard "through her feet." At this time her sense of smell was such that she could distinguish the odors of some more fragrant flowers, but eau-de-Cologne, ammonia and onions were thus recognized only when quite strong. Contrary to what was stated for an earlier period, she was found least sensitive to bitter and acid tastes, and most sensitive to sweet and salt. It was concluded that out of the four defective senses, taste alone was well enough preserved to materially aid in developing her notion of the external world. A study of discriminative sensibility for two compass points showed a discrimination in her case, from two to three times as acute as that of a seeing person. To temperature, her sensitiveness was not remarkable, and hence the "facial sense," as it is sometimes called in the blind, was not well-developed in her, though she was said to recognize the approach of persons by the undulations of the air. She was found sensitive to rotation, which made her dizzy and gave her a feeling of nausea.

In the course of her life Laura was the author of "a Journal, three Autobiographical Sketches, several so-called poems and numerous letters." The Journal covers a period of about ten years. Dr. E. C. Sanford([7]), who has made a

study of her writings, sums up her mental development as thus indicated, by the statement that "she was eccentric, not defective; she lacked certain data of thought, but not, in a very marked way, the power to use what data she had."

She died at the Perkins Institution, where she had spent almost her entire life, on the 24th of May, 1889, being in her sixtieth year.

Laura excited wide interest because, for the first time in her case, several experiments were tried and questions tested, with unprecedented results. Her case was used for research in matters pedagogical, psychological and theological. But these are passed over, as they lie outside our present scope.

Her defect is often regarded as almost unique. As a matter of fact, if the deficiency of smell and taste is counted with that of sight and hearing, there appear to be few cases like hers; but so small is the educational value of the first two named, that she may be fairly classed with the blind deaf-mutes, in which, for the most part, the state of smell and taste is not recorded. As Prof. Edwards A. Park says in the introduction to Mrs. Lamson's book([1]), there are some fifteen cases recorded of persons who have lived as blind deaf-mutes. Dr. Howe formed his plan for the instruction of Laura from the study of Julia Brace, who was a blind deaf-mute. There were several similar cases at the Perkins Institution during Laura's lifetime, and there are two young girls in that institution now who are defective in the same way. Special descriptions of one or more cases have been given by Mareschal([8]), Fowler([9]), Burdach([10]), Alessi([11]), Sichel([12]), Fuller([13]) and Borg([14]); and Mrs. Lamson, in the current number of the "American Annals of the Deaf,"([5]) mentions a Norwegian girl, Ragnhild Kaata, who is blind and deaf, but having been taught to articulate, can no longer be described as mute. In the same article is mentioned a school in Sweden where five blind deaf-mutes are being instructed. Finally, I may call attention to the fact that in the Census of 1871 for Great Britain there are 111 returns for blind deaf-mutes([15]), while in the 10th Census of the United States, in the analysis of

statistics relating to the defective, dependent and delinquent classes by Wines([16]), there are returned:

Blind deaf-mutes,	256.
Blind deaf-mutes, also idiotic,	217.
Blind deaf-mutes, also insane,	30.

The literature on this subject would probably be found to be extensive if carefully gathered, and the statistics, if taken from all sources, would show a very considerable number of individuals in this class. It is my purpose, however, only to call attention in a general way to this point, as bearing on our subject. Taking the Census of 1880 for the United States, Laura's case could only be compared with the simply blind deaf-mutes—256 in number—and it would need a careful analysis of this group in turn, to show how many cases were strictly comparable with hers. There is good reason to think, however, that a number of such would be found.

I do not know that we are in a position to say from sound data what the effect of loss of the senses—as in Laura's case—is on the mental integrity of the individual, but certainly the proportion of blind deaf-mutes who are also mentally defective is very large. At the same time there is reason to think that the large number of those who are idiotic were either congenitally defective (the idiocy and the other defects having a cause in common), or that they became defective shortly after birth, and were neglected by those in charge of them. Two points came out in a striking manner in looking over these cases as presented in the literature just cited. The first is, the small amount of mental pabulum which serves to keep the action of the mind normal; and second, the late stage (measured in years) at which instruction may be begun with fair hope of success, the nervous mechanism apparently retaining for an unusually long time the impressionability which in the normal person belongs to early childhood.

Physical Data and Report of Autopsy.

On her entrance into the Perkins Institution, some physical measurements were taken, which were unfortunately lost. At eleven years of age her height was 4 ft. 4.7 in. (1.33 M.). Her head measured 20.8 in. (52.8 cm.) in circumference,

along a line passing over the prominences of the frontal and parietal bones. Above this line the head rose 1.1 in. (2.8 cm.), and was broad and full. From the orifice of one ear to the other, the (*shortest*) distance was 4 in. (10.1 cm.), and from the occipital spine (*protuberance?*) to the root of the nose, it was (*shortest distance*) 7 in. (17.7 cm.). The forehead was said to have grown perceptibly larger during the two years preceding ([2]-p. 181). These are the only data that I have been able to find. As nearly as I can learn from those best acquainted with her at the Perkins Institution, her height at maturity was 5 ft. 3 in. (1.596 M.), and her weight, with clothing—98 lbs. avoirdupois (44.45 kilos).

During her residence at the institution, she appears to have had no serious illness up to the time of the one which proved fatal, although often in poor health as the result of over-exertion in her study or from emotional excitement, as for example that caused by the death of Dr. Howe, to whom she was deeply attached. Her final illness lasted about three weeks, and she sank gradually to a painless death—before, it is said, advancing years had perceptibly impaired those faculties which she exercised. The autopsy was performed eight hours after death, by Dr. E. S. Boland, of South Boston, in the presence of several gentlemen. The cause of death is stated as lobar pneumonia. Aside from the lungs, the other viscera appeared healthy save the left kidney, which was slightly atrophied. The encephalon was removed in the *dura* with the eyes attached, and the petrous portions of the temporal bones and part of the ethmoid were also taken out. The cranium is described as symmetrical and of good shape and size; bones thin; diploë slightly marked; but little subdural fluid; the encephalon fitting the cranial cavity closely; *dura* normal in appearance. For the above facts I am directly indebted to Dr. E. S. Boland. The encephalon was not weighed at this time, nor was any further examination permitted. For the next seventeen hours it was kept in a moderately cool place, but not in any fluid. At the end of this time it came into the hands of Prof. W. F. Whitney, who very kindly took charge of it. The specimen was now in such a condition that it was deemed best to cut it in various directions, in order to permit

the hardening fluid to penetrate. Four transverse incisions were made, the first being about 3.5 cm. from the frontal end, and the other three at equal intervals behind it. The depth was such as to open the lateral ventricles in either hemisphere without injuring the *callosum* or basal ganglia. Along the mesal surface of each hemisphere a longitudinal cut was made, extending about the length of the *callosum* and laying open the lateral ventricle on each side. The entire material was then put into several litres of Müller's fluid plus one-sixth its volume of 95% alcohol. This fluid was changed some four or five times in the period between May 25th and July 10th, at which time the specimen came into my possession. The eyes were then separated from the encephalon, and they with the portions of the bones, were treated by themselves. The encephalon was hardened for some three months more in 2½ % potassium bichromate; kept for a long time in a dilute solution of the same; finally washed out, hardened in 95% alcohol, and preserved in 80% alcohol. The majority of the measurements were made while it was in the 2½% or dilute potassium bichromate.

Photographs and Models.

In studying the encephalon, it was necessary to make those observations which required least dissection first, and so proceed that the different portions should retain their normal connections as long as possible. The results, however, under any head, will be given without reference to the order in which they were obtained. As the complete examination required ultimately a dissection of the encephalon, with consequent loss of form, I first had it carefully photographed, the encephalon being taken from six points of view, and then the mesal surface of each hemisphere taken alone. The entire exposed surface, with the exception of that covered by the cerebellum, is thus represented, and this latter surface was sketched. It would be extremely desirable to have these various views adequately represented, but since the means for so doing are not at present at my command, I have preferred to await some future opportunity rather than to represent them now by some method of doubtful value.

It was further extremely desirable to have an accurate model of the encephalon. The character of the specimen, the cuts in it and the method of preservation were all against any device for taking a direct cast of it. I was, therefore most fortunate in securing the co-operation of Mr. J. H. Emerton, of Boston, whose skill in modelling such objects is well known. He made an accurate clay model of the specimen; from this a glue mould was taken, and a number of plaster casts were at once made from this mould, before it had time to undergo any distortion, the original clay model being preserved for comparison. The results are entirely satisfactory, and we have now what is equivalent to a good cast of this specimen. In making the model, the cuts in the hemispheres were not represented, and thus the general appearance was improved without any material loss in accuracy.

Envelopes and Vessels.

Within the limits of this paper I shall have to deal exclusively with questions relating to the gross anatomy of the specimen.

Dura: Sinuses filled with blood. Normal in appearance. It was incomplete at several points on the ventral aspect of the hemispheres and the cerebellum was completely exposed, the *tentorium* and *falx* being both present. This somewhat defective membrane, including *tentorium* and *falx*, weighed, after hardening by the method above described, washing out in water, and being pressed between filter papers, 54.4 grms. No data for comparison have thus far been found.

Pia: The vessels were filled with blood. To all appearance it was normal. The adherence to the occipital regions appeared uncommonly strong, even making allowance for the close adherence which is normal for this region. The *pia* from the entire encephalon with the choroid plexuses, but without the basal blood-vessels, was treated like the *dura* and found to weigh 25.1 grms. The quantity of the *pia* obtained was estimated at about .8 of the total. That supposition being correct, the total *pia* would weigh 31.4 grms.

What the influence of the hardening process is on the weights of the membranes, *dura* and *pia*, is not known, but

it is presumptively slight. Giacomini([17]) has made observations on the weight of the *pia* and cerebro-spinal fluid, which I give. It is to be remembered that we have no means of knowing the quantity of the fluid in our case, though the autopsy report states that there was apparently little at that time. Confining himself to the cerebral hemispheres, which were weighed separately, Giacomini found in 30 normal brains the weight of *pia* and residual cerebro-spinal fluid (the bulk of the fluid having escaped on the hemisection of the cerebrum, and having been then collected) to be from 5 to 5.5% of the weight of the hemispheres. Where the vessels of the *pia* were congested, the percentage might rise to 6 or 6.5%. According to Calori, quoted by Giacomini, the weight of the *pia*, blood and cerebro-spinal fluid for the whole encephalon is 14% of the entire weight. This figure seems to Giacomini too high. Huschke([18]) calculates that removal of the *pia* and choroidal plexuses from the cerebral hemispheres alone diminishes their weight by 50—60 grms. (This diminution is plainly in part due to loss of fluid consequent on removal of the *pia*). Bischoff([19]) gives 25—40 grms. for the *pia* of the cerebral hemispheres alone. Bastian([20]) gives 21—28 grms. for the *pia* of the entire encephalon. Where the brain is sliced and allowed to drain for 1—2 hours, according to the method of Thurnam([21]), there is, according to Bastian, an additional loss of 28—56 grms. Bischoff([19]) gives further figures from Weisbach, Hagen and Marshall, which I have not been able to verify, and therefore omit.

There is here hardly sufficient data on either hand for the purposes of comparison, but the assertion may be fairly made that the *pia* in our case shows no marked peculiarity. Unfortunately, the conditions do not permit us to follow Giacomini's ([17]) suggestion, and infer from the weight of the *pia* its relative thickness.

Volume of Encephalon.

On Aug. 13, 1889, while the specimen was still in 2½% potassium bichromate, an effort was made to obtain the volume. The encephalon (deprived of *pia*) was put in a large jar filled with water. On the water floated a cork, in the centre of which a long pin was stuck vertically. A ruler

laid across the top of the jar formed a line to the level of which the top of the pin rose when water was poured into the jar. The encephalon being in the jar, water was then added until the head of the pin was level with the edge of the ruler. The encephalon was next removed, with all precaution as to drainage, etc., and the quantity of water was measured which had to be added to that in the jar in order to bring the pin-head to the same level. Two determinations were thus made:

Determination 1 gave volume = 1385 c.c.
" 2 " " = 1381 c.c.

Mean, = 1383 c.c.

This figure, 1383 c.c., I have taken to represent the volume under the conditions stated.

The cuts in the specimen were such that there is good reason to think that the lateral ventricles were filled by the fluid in which it was immersed. The method, I am aware, was rough, but was the best at my command at that time. The most important correction to be made is that for the change of volume of the specimen due to the process of hardening to which it had been subjected. On this point some experiments have been made, which are not yet ready for publication. I shall, however, use the facts obtained without further proof, trusting that I may soon be able to give evidence of their correctness. To save any repetition, it may be here stated that the experiments just mentioned relate to the volume, weight and specific gravity of the encephalon, and will be introduced under their proper headings without further remark.

If an encephalon is treated like that of Laura (from six to twelve hours after death), the conditions for its preservation in the mean time having been good, it will show an increase equal to about 25% of the initial volume. This, however, takes place only when the specimen is fairly fresh. When it is not fresh, but still hardens slowly and incompletely, the increase may be about 2% of the initial volume. In our case it is a fair estimate that one-third of the initial mass of the encephalon is hardened so as to have undergone an increase of but 2% in volume, while the other two-thirds may

be considered to have undergone the full enlargement of 25%. Making use of the above percentage for correction, the volume observed would be $\frac{88}{75}$ of the initial volume, or

$$\frac{1383 \times 75}{88} = 1178 \text{ c.c.} = \text{initial volume.}$$

The value of this figure is simply that of the best approximation which I can now make.

Weight.

At the same time that the volume was taken the specimen was weighed. The weight thus obtained (on balances weighing to 0.1 grm.) was 1389.5 grms., the *pia* being completely removed. The hardening of the specimen had caused it to increase in weight about 22% for those parts which were well hardened. The same conditions determine the amount of this increase in weight that determine the increase in volume, and when the specimen hardens imperfectly the increase in weight is a trifle less than 2%, but may be called 2% for the present purpose. Supposing, as before, that two-thirds of the initial brain-mass have increased 22% in weight, and one-third 2%, we have, 1389.5 grms. = $\frac{173}{150}$ of the initial weight, or

$$\frac{1389.5 \times 150}{173} = 1204 \text{ grms.} = \text{initial weight.}$$

Any criticism which can be applied to the volume can also be applied to the weight as thus deduced.

The initial specific gravity of this encephalon or any portion of it is not known, but if we deduce it from the calculated weight and volume, it is 1.022. This is a smaller figure than Bischoff([19]) found. For female brains, his figures are from 1.0305 to 1.0478. The determination of the weight in this case is, in my opinion, less subject to error than the determination of the volume. If we consider a brain of this weight to have either of the extreme specific gravities given by Bischoff or one represented by their mean, we have for a brain weighing 1204 grms.,

sp. gr. 1.0305 giving a volume = 1168 c.c.
" " 1.0391 " " = 1158 c.c.
" " 1.0478 " " = 1149 c.c.

Thus furnishing figures for the volume which are 10, 20, and 29 c. c. below those first calculated.

Further manipulation of these figures would be of little value. It is concluded, however, that the probable weight of Laura's brain was somewhat over 1200 grms., and that the probable volume was about 1160 c. c.

The mean weight for the English and European female encephalon is variously given. Bischoff([19]), 1244.5 grms.; Tiedemann, 1275 grms.; and Huschke, 1272 grms. Schwalbe([2]) gives 1245 grms., as deduced from a composite table of weights. This table further shows that out of the 339 cases which it includes, 283 have a weight between 1100 and 1420 grms., and the majority (two-thirds) of these in turn have a weight between 1160 and 1330 grms. Our specimen, therefore, falls within these last limits, but somewhat below the mean, 1245 grms. The figure which we have obtained will not warrant any discussion of the weight in relation to other conditions of age, body-weight and height. It may nevertheless be pointed out that our specimen had probably not undergone any important loss of weight due to advancing age, and that furthermore it is possible that the figures which have led to the generalization that at about sixty years the encephalon begins to lose in weight, may perhaps, as has been suggested, be as well explained by some relation not yet investigated, between brain weight and longevity.

Of the subdivisions of the encephalon, the cerebellum alone was weighed separately. It was separated from its connections by cutting through the peduncles as close to the hemispheres as was practicable. The portion thus removed weighed 163 grms. The increase in weight due to hardening is about 27% for the cerebellum, which would make the initial weight 128 grms. Taking the weight of the entire encephalon as 1204 grms., then the cerebellum is 10.63% of the entire weight. This percentage is exactly that found by Weisbach and 0.17% lower than that found by Meynert, as quoted by Schwalbe([2]). It serves to show that there was nothing very peculiar in the weight relations of the cerebellum to the rest of the encephalon in this case. The

other weights which are usually recorded could not be taken, because further dissection of the brain was impracticable in view of the other observations to be made on it.

Linear Measurements.

On Nov. 4, 1889, the following measurements were made:

Greatest length of left hemisphere,	178 mm.
" " right "	**180** mm.*
The maximum width of cerebrum,	153 mm.
The maximum height of cerebrum,	129 mm.
The longest perpendicular distance, taken on the mesal aspect of each hemisphere, from the line measuring the length of the hemispheres to the dorsal surface, is in this case the same for both hemispheres,	73 mm.
The encephalon being in the normal position, the distance between a perpendicular plane just touching the tips of the temporal lobes and one just touching the tips of the frontal lobes was found to be	57 mm.

Schwalbe's([22]) figures for similar dimensions in the female brain are, greatest length in the majority of cases, from 150 to 160 mm., the limits being 142–189 mm. (Huschke). The mean breadth is given at 140 mm., whereas the height is given at 125 mm. For the longest perpendicular as above described, and the distance from the tip of the temporal to the tip of the frontal lobes, I find no data that are comparable. For comparison on the last measurement, I have used three male brains which were hardened in bichromate and alcohol in the usual manner, and which are nearly the same length as our specimen, (from 2 to 11 mm. longer). In these the temporo-frontal distance, if I may so call it, was respectively 47, 41 and 51 mm., as compared with 57 mm. in Laura.

Of course, the swelling of the encephalon due to hardening has increased all three diameters, and so the figures given for Laura cannot be compared with those from Schwalbe until some correction has been made in them. Such correction I am at present unable to make. Assuming, however, that the enlargement along the several diameters is proportional to their initial length, we can make the calculation for the

* Where similar measurements for the two halves of the brain are given, the larger figure is in heavier type. It is hoped that this device will render the comparison of the two sides easier.

cerebral index, the mean length being taken as 179 mm., and breadth 153 mm. The so-called cerebral index, obtained by dividing the latter by the former, equals 85+, showing the cerebrum to be markedly brachycephalic. The excessive temporo-frontal distance appears plainly to be due to deficient development of the temporal lobes.

General Description of the Encephalon.

In order to give some data for the control of the foregoing measurements, a general description of the specimen will be useful. To the medulla was attached a piece of the cord which extended 17 mm. from the superficial caudal termination of the decussation of the pyramids. This length was about that usually obtained where the cord is cut through the *foramen magnum*. The shape of the specimen was well preserved, owing to its having been hardened in the *dura*. The angle between the stem and cerebrum was approximately normal, and the relation of the cerebellum and hemispheres therefore but little disturbed. The hemispheres overlapped the cerebellum slightly. The vessels forming the circle of Willis were certainly not large. Of the internal carotids the right was the larger, but only slightly so, and the posterior communicating arteries were small, even in proportion to the other vessels.

In passing now to the several subdivisions, no effort will be made to give a complete description, for the nature of the specimen is not such as to demand that, and all exact measurements will be left until the parts are studied histologically.

Medulla and Pons.—The nerves from this region were identified, except the spinal accessory, which could not be found, having been probably pulled away in removal of the specimen. Here, of course, it is the *glossopharyngeus*, the *acusticus* and the *abducens* associated respectively with the sense of taste, of hearing, and the external rectus muscle of the eye-ball, that are of special interest. These appeared somewhat reduced in size, though all the cranial nerves were small. On the ventral aspect of this region, neither the olivary bodies nor the pyramids were prominent. The anterior

median sulcus between the pyramids was well marked, as was the ventral depression on the *pons*. On the lateral aspect, the *corpora restiformia* appear well developed. On the dorsal aspect, the floor of the fourth ventricle was seen to be clearly marked. There was a well developed *ligula* and *obex*. The nuclei of the *columnæ graciles* made evident swellings in the course of the dorsal columns of the cord, those of the column of Burdach being less marked. On the floor of the ventricle, the *alæ cinereæ* and *trigona hypoglossi* were very evident. The *striæ acusticæ* or *medullares* were particularly clear. The point is of interest, since the *striæ* are looked upon as part of the auditory path in this region. A more detailed description of them will be given later.

Cerebellum.—As we have seen, the cerebellum has thus far offered no peculiarity. The peduncular connections were as usual, and a sagittal section shows the *arbor vitæ* with the characteristic sub-divisions. In the general conformation, there was nothing to excite remark.

Mid-brain.—The oculo-motor nerves were, perhaps, a trifle small. The *trochlearis* was not found. On the ventro-lateral surface, a search for *tractus peduncularis transversus* of v. Gudden([23]), which appears to have some connection with visual apparatus, was unsuccessful. However, it must be remembered that this tract is not always superficial in normal individuals, and therefore failure to detect it is not proof that it has degenerated. On the dorsal aspect, the *frenulum* was well marked. The posterior pair of the *corpora quadrigemina* was rather small, but well rounded and both alike. The median groove, the transverse groove separating them from the anterior pair, and the *brachia*, were all well marked. The anterior pair of the *corpora quadrigemina* were much flattened towards the middle line. *Brachia* not evident.

As the result of the cuts necessarily made to allow the entrance of the hardening fluid, and the failure of this region to harden, subsequent dissection has yielded but small results. Of the condition of the *corpora geniculata* on the right side, nothing can be said. On the left side the *corpus geniculatum internum* can alone be described, and this was comparatively large and prominent.

Inter-brain.—On the left side of the specimen the *pulvinar* had been preserved, and there it was reduced in all dimensions, and but little arched; on the other side it had broken away and could not be described. The caudal portion of the third ventricle was large. There was a well developed median and posterior commissure. The general lack of development in this inter-thalamic region is not shared in by the pineal gland and its connections, the *habenulæ* and *trigona habenulæ*, which were disproportionately enlarged—an enlargement which is probably due to the removal of pressure from the surrounding structures. Turning now to the ventral surface, the *corpora mammillaria* and, it may be added, the *fornix*, were normal. About the pituitary body, there was nothing peculiar, but the *infundibulum* is prolonged ventrad to an unusual degree, and is bounded on either side by the greatly shrunken optic tracts. The relations of the anterior commissure in view of its connection with the olfactory centres would have been interesting, but the specimen did not show this commissure, owing to imperfect preservation.

Before proceeding to the *callosum* and the hemispheres, it may be well to consider what we should expect to find in these portions. There is no suggestion in this case that would lead us to anticipate appearances such as are recorded for microcephalic, criminal, or low-type brains belonging to the least civilized races. Neither is the case to be associated with those in which the defect or arrest of development was due to causes originating within the central nervous system. There was not the slightest indication of abnormal mental action, and therefore the brain would not be expected to resemble that of the insane, if for the moment we admit that the brains of the insane show gross peculiarities. What we have is the brain of a normal person who lost at about two years of age the senses of sight, hearing, smell and taste, through injury to the peripheral sense-organs, but who remained mentally balanced throughout a long life, though under conditions which would favor mental derangement, had the tendency to it existed. This loss would have but a moderate power to destroy what was already formed in the brain, though it would do so to some extent.

The chief effect would be to retard the further development of those portions which represented the lost senses, but even here the hereditary laws of growth would act to some extent independently of the modifying conditions which existed in such a case.

As a point of departure, then, it would be interesting to know what was the state of development of an average female brain at the commencement of the third year of life. If we take 1245 grms. as the average weight of the female encephalon, we find that at the commencement of the third year or end of the second, the average weight is about 920 grms. for females. [See Boyd's tables quoted by Schwalbe([22]), and Bischoff's([19]) table of five observations, made up from those of Huschke and Sims. The figures quoted by Vierordt([24]) are not available, because no distinction of sex is made, and, as is well known, such a distinction exists at birth and even in the fœtus.] If 920 grms. is the true figure, then at this age the weight of the encephalon is about three-fourths that of the adult. As the specific gravity is somewhat less, its volume is proportionately a trifle greater.

On the relations of the nerve-cells and fibres, not much can be said that is satisfactory. Whether we have the elements all formed at birth, and they undergo simply an increase in size during the subsequent processes of growth, so-called, or whether we have new elements formed after birth, is a question for the decision of which the evidence is as yet scanty. Schiller([25]), at Forel's suggestion, determined with due precautions the number of nerve-fibers in the *oculo-motorius* of kittens at birth, and cats at the end of the first year, and found practically the same number in both cases. In this animal and this nerve the number of fibers, then, does not increase after birth. In man, however, the period of helplessness and development after birth is comparatively long, and Below([26]) has found in animals that the cortical cells are less developed in those born helpless than in those born in a more mature state. Incompleteness in the development of the central nerve-cells would favor the idea that they might still undergo multiplication after birth. As a matter of fact, the development of the cortical cells in the human fœtus is incomplete

at birth (Obersteiner[27—p. 867]), and the development of medullated fibers far more incomplete. The medullation of fibers is continually going on during the early years of life, and there is evidence that it is for the most part completed about the eighth year. For those who hold that practically the number of elements is fixed at birth, the increase in the size of existing elements, and especially the medullation of the fibers, are the causes of the enlargement of the encephalon. If such is the case, however, and Galton's[28] measurements on the heads of Cambridge undergraduates mean what he takes them to mean, *i. e.*, brain growth, then the process of medullation or enlargement, or both, must continue in some cases up to the twenty-fifth year.

If we turn now to the sulci and gyri, we find all the important ones present at birth [Ecker[29], Rüdinger[43]]. At that time, the cerebral surface is marked in a typical manner, and according to Ecker the asymmetries which occur in the sulci are caused by the later development of accessory sulci. What the history of these accessory sulci may be, has not, I believe, been studied, and how far they may be developed during the first two years of life, is therefore an open question; but *a priori* one would imagine that the earliest years of life would be the time when they would appear. Be that as it may, it seems highly probable that the relations of the primary and secondary sulci are fixed to a large extent at birth, and that subsequent development has but a slight influence in altering these relations.

In the child at birth, and during the first years of life, the relative development of the several lobes of the brain is not the same as in the adult. Designating the lobes as occipital, temporal, insular, parietal and frontal, Bischoff[19] states that it is the last two which develope most in later years, and of these the parietal undergoes the greatest enlargement; but the observations on this point are few.

Applying the above conclusions to our case, we may describe Laura's brain at the age of two years as having about three fourths of its adult weight, the cells of the cortex being fairly developed, whereas the medullation

of the fibers was incomplete to a considerable degree. The primary and secondary sulci were all present, and probably some of the accessory sulci also; and the parietal and frontal lobes were less developed than they should be in the adult. If the *callosum* is commissural for the different portions of the cerebral cortex, we might expect it to accompany the cortex in development. In the absence, so far as I am aware, of explicit observations on this point, we may assume the *callosum* well developed at this age.

On such a brain as we have described, what would be the effect of a lesion, like that which occurred in the case of Laura? The nerves and their primary centres would show degeneration, and later some atrophy, then after the lapse of time, arrest of development, in so far as they were incompletely developed at the date of the injury. In the cortical regions, so far as they might be affected, we should probably expect some arrest of development which would show itself on gross examination, and certainly some histological indications of arrest and possibly degeneration. Further, as one result of the limitation in mental activity due to the great defect in the senses, a general appearance of immaturity might be anticipated, while if certain lobes were affected more than others, a disproportion in development as compared with the normal would result. It seemed advisable to make some analysis of the case at this point, in order that no ungrounded expectation of striking anomalies might be cherished, and it will be the chief purpose of the following pages to show in how far actual observations bear out the views above advanced.

Callosum.—The *callosum* was well developed. On the surface exposed by a sagittal section dividing the two hemispheres, the distance of a straight line between the extreme points was 82 mm., while a line following the dorsal curve and joining the same points, is 87 mm. long. The height or thickness, as one chooses to call it, always measured vertically (the hemispheres being in the normal position) is 22 mm. at the rostral end, 12 mm. in the middle, and 15 mm. at the splenial end. The area of surface exposed by the section was 1172 sq. mm. The linear measurements exceed somewhat those given by

Krause([30]—Bd. 2, p. 965), especially those for the thickness, but I am not sure that mine were taken in the same way as his were; and furthermore, his apply to the fresh specimen, while this was swollen by hardening. Comparison with other specimens hardened in potassium bichromate, shows these figures nevertheless to be large. From gross examination, therefore, the *callosum* appears to have developed completely.

Cerebral hemispheres.—On looking at the hemispheres, the general shape appears normal, but they are somewhat flattened at the occipital pole. The temporal lobe is comparatively small, the tip being thin, and on the orbital surface of each hemisphere at the cephalic end is a marked conical elevation of the general surfaces with the apex directed ventrad. This elevation appears on either side of the median line, just in front of the point where the *sulcus olfactorius* terminates. As the formation is not usually described, and is only faintly suggested in most brains, it is probably an anomaly due, in this case, to the failure of the orbital plates of the frontal bone to develop in the usual manner, thus leaving more of a depression in the bone at this point than ordinarily occurs. To this depression the brain has accommodated itself, with the result of producing the appearance described. When viewed from above, the general effect was quite similar to the typical female brain, as depicted by Wagner([31]), the chief difference being that our specimen was not quite so pointed in the frontal region as Wagner's plate of the female brain, and had the gyri in the occipital region in less relief. The gyri were for the most part widely separated from one another, especially in the frontal and parietal lobes whereas in the occipital they tended to be close together. In general, the gyri were large, but little interrupted and moderately sinuous, and the insula was more exposed on the left than on the right side. The typical arrangement of the gyri was easily followed, and the two hemispheres quite symmetrical in their markings. The symmetry of the hemispheres, the continuity and size of the gyri, may be taken as indicating an average or perhaps less than average development in these respects. Such a statement has, however, so little foundation that is measurable and exact, that it will be best to leave it in the form of a

mere suggestion. There is some departure from symmetry in the two hemispheres, where, on the mesal surface of the occipital region, the ventro-caudal portion is smaller in the right hemisphere. This is shown in an exaggerated way in Plate II, Fig. 4.

As illustrating the general development of this specimen, I introduce here several measurements which were made while the brain was in potassium bichromate.

Taking the smaller angle which the *fissura centralis* makes with the middle line, following the method of Eberstaller([32]), it was found to be,

For left hemisphere,	65°.
For right hemisphere,	61°.

This is smaller than is usually stated. Wilder([33]) gives 67° as an average, and Eberstaller 70°–75°.

If we take the entire length of the mesal edge of the hemispheres measuring from the *trigonum olfactorium* to the occipital pole, and then the distance from the *trigonum olfactorium* to the point where the *fissura centralis* reaches the mesal surface, we obtain the following figures:

Left hemisphere, entire distance,	334 mm.
Right " " "	331 mm.
Left hemisphere, distance to *fissura centralis*,	214.5 mm.
Right " " " "	216 mm.

This, reckoned in per cent. of the entire distance, gives the last distance or extent of frontal lobe along this line, as

Left hemisphere,	64+%.
Right hemisphere,	65+%.

Eberstaller([32]) gives for the female brain, 66%. Our figures, therefore, approximate closely to his average. Measuring the *fissura Sylvii* on each side from the point where it gives off the anterior *rami* to the point where it gives off the *ramus posterior ascendens*, it was found,

For the left hemisphere,	53 mm.
For the right "	52 mm.

This makes it shorter than the average figures for females found by Eberstaller([32]), which was 56.5 mm.

Among these figures, one set (namely that for the position of the mesal end of the *fissura centralis*) is in

percentage, and that agrees fairly well with the results of other authors. It may be presumed, then, that in hardening the encephalon has not undergone much distortion. If that is true, then the small angle of the *fissura centralis* with the middle line is probably a true relation. Despite the enlargement of the specimen, the length of the *fissura Sylvii* as measured is under the average, but the relations of the two sides are as Eberstaller found; that is, the left is the longer.

The condition of the ventricles was not easily made out, owing to the state of the specimen and the cuts in it, which somewhat disturbed the connections here. The lateral ventricles were certainly not large. The descending *cornua* were well developed, but the right posterior *cornu* terminated 47 mm. in front of the occipital pole. In the left hemisphere it reaches to within 42 mm. of the occipital pole, and there is a well developed *calcar* which was not observed on the right side.

Description of the Surface of the Hemispheres.

As was stated earlier, it is not my purpose to describe in detail the cerebral surface in this case,—as good plates would give a far better idea than could be obtained from the text,—so that on this occasion I shall be content with some outline figures and a description of those regions which may be regarded as important. The four representations of the specimen were drawn from photographs by means of a pantograph. From these drawings the plates were made by one of the photo-engraving processes. In the figures those sulci which are more constant are put in with a heavy line, whereas the others are in light lines. In the case of the fissure of Sylvius an approximate presentation of the amount of separation of the gyri has been attempted. In the description I shall follow Eberstaller([32, 34]) in most points and also adopt his nomenclature.

Frontal Region.—In Figures I and II, the *sulcus frontalis medius*, *f* 3, is clearly marked, thus giving the four frontal gyri, (by sub-division of the *gyrus frontalis medius*,) which the more recent authors are agreed is the normal condition of the frontal lobe. [Eberstaller([32]), Wilder([33]),

Giacomini([17]).] To be noticed on the left side is the union of the *sulcus frontalis inferior*, *f* 2, with the *sulcus fronto-marginalis*, *fm* 3, which appears somewhat unusual. Further, on the same side the *ramus anterior horizontalis fissuræ Sylvii*, *S* 3, runs into the *sulcus fronto-marginalis*, *fm* 1, but at the junction there is a vadum or shallow, (see Wilder, [33]) which clearly marks the usual limits of this *ramus*. Aside from these points the fissuration of both frontal lobes is quite typical. Directing attention to the *gyrus frontalis inferior* we find it well defined laterally and frontally, but as is usual, poorly defined on the orbital surface. In its entirety that of the left does not differ much from that of the right hemisphere, but there are some differences in detail. Dividing the opercular portions into the *pars orbitalis* ventrad of *S* 3; *pars triangularis* between *S* 3 and *S* 2; *pars ascendens* between *S* 2 and *d*: and the *pars basilaris* between *d* and *pci*, we find the *pars basilaris* much less well developed on the left side, being especially deficient in its ventral portions. The *pars ascendens* is deficient throughout on the left side while the *pars triangularis* is somewhat better developed on this side than on the right. A comparison of the orbital areas is not practicable in this case. It should be added that, on the left side not only is the exposed surface of the *pars basilaris* and *pars ascendens* smaller, but both these are sunken below the surrounding gyri; the former completely and the latter in its ventral portion, the frontal edge of the *gyrus centralis anterior* forming a slight operculum over the *pars basilaris*.

It is our purpose of course to determine whether these features of the left side can be properly brought into connection with the very limited power of articulate speech possessed by Laura. There is good ground for the view that in right handed persons it is the portion of the *gyrus frontalis inferior* of the left side between the *ramus anterior ascendens fissuræ Sylvii*, *S* 2, and the *sulcus præcentralis inferior*, *pci*, that is the centre for articulate speech. So far as known Laura was right handed. According to Eberstaller([32—p. 104]), the *pars basilaris* may often be sunken, but in such cases, where the brain is normal, the *pars ascendens* overlaps and more or

less conceals it. In this case no such overlapping occurs. Several authors have called attention to the value of the comparison of the two hemispheres of the *same* brain where a lesion was suspected on one side, and judged by that test we certainly have defective development of this gyrus on the left side. A variation, however, which seems to me of considerable importance, is the direction of the *sulcus diagonalis, d.* One characteristic of this sulcus is that in the normal brain its dorsal end lies further caudad than the ventral end. On the left side in Laura this direction of the sulcus is reversed, the ventral end being further caudad and to all appearance it occupies this anomalous position because the ventral portion of the *pars basilaris* has failed to develop. On the right side it has the normal direction.

In this connection the exposure of the *insula* is significant. I estimate this exposure for Laura:

On the left side,	128 sq. mm.
On the right side,	46 sq. mm.

That is, the surface of the *insula* exposed on the left side is nearly three times that exposed on the right. In looking at the collection of brains in the museum of Cornell University—a collection which has been gathered by Prof. B. G. Wilder,—I found no exposure of the *insula* which approached even that on the *right* side in Laura, save in the *left* hemisphere of a negro (catalogue number, 322), in which the exposure was somewhat less than on the right hemisphere in our case. Of course the absolute relations of the specimens have at present no value since the Cornell brains were hardened in alcohol and therefore had undergone some shrinkage. It may, however, be permissable to conclude that on both sides the exposure of the *insula* in Laura was large, and that on the left side it was much larger than on the right.

Exposure of the *insula* may be considered in general as characteristic of incomplete development (Rüdinger[35]). According to this test, then, there is here a general lack of development which is most marked on the left side. This exposure is due, however, only in part to the small size of the *gyrus frontalis inferior* which contains the presumptive speech centre, and to which we have hitherto

specially attended. Rüdinger([35]—p. 45) describes for mutes that have lost the power of speech as the result of deafness and who are otherwise normal, certain slight abnormalities of the speech-centres — but seems surprised that they are not more marked. Without entering into any detail it is evident that the variations in his cases and in that of Laura are similar, and Zuckerkandl([36]) also notes as defects in the development of the speech-centre some that we do not find here, but among those that we do find, he mentions the depression below the general surface of the *pars ascendens* and *basilaris*, the hiding of them by surrounding gyri, which thus form an operculum at this point, the exposure of the *insula* and failure of the tip of the temporal lobe to attain its full size. Zuckerkandl([36]) has also something to say with regard to compensatory development on the assumption that such compensation may be physiological as well as morphological. Whereas the *pars ascendens* and *basilaris* are less well developed in the left hemisphere in Laura, if the *pars triangularis* of the left side is compared with that of the right it is found to be somewhat larger. It might be urged that this better development of the *pars triangularis* indicated that it had taken on some of the functions of the undeveloped portion. At the moment I am aware of no positive evidence in favor of such a transfer of function and hence do not consider the objection important. Closely associated with this region is the *insula*, but the discussion of that will be deferred until we consider the cortical development of the brain. From what has been said, then, I conclude that the centre for articulate speech in this case shows some defect, which is most naturally explained as arrest of development. The nature of this arrest will be brought up when we come to the histology of the region.

Occipital Region.—We next turn to the occipital region which is represented in Figs. III and IV. The occipital lobe, and specially the *cuneus*, in man, appears to be the cortical centre for vision,— but just what the limits of the occipital lobe are, and how much of this area is specialized as a visual centre, are not precisely determined. Ecker's([37]) description of the occipital lobe has not been found satisfactory by later au-

thors and several attempts have been made to improve on his account. Here I follow Eberstaller's description([34–No. 18]). According to him the occipital lobe is best considered as that portion of the hemisphere enclosed between the *fissura calcarina* (*ca*), the *sulcus parieto-occipitalis* (*p. o.*), the *sulcus occipitalis anterior* (*occ. ant.*) and the *sulcus occipitalis lateralis* (*occ. lat.*). The *sulcus occipitalis anteriqr* is the homologue of the "ape fissure" of the authors. The gyrus between the mesal end of the *sulcus occipitalis anterior* and the *sulcus parieto-occipitalis* is the *gyrus annectans superior*, while that between the lateral end of the *sulcus occipitalis anterior* and the *sulcus occipitalis lateralis* is the *gyrus annectans inferior*. The complete enclosure of the area must be to some extent artificial, but I shall make it by joining the several sulci with one another at the points where they come nearest together, using the two ends of the *sulcus occipitalis anterior* and the caudal end of the *fissura calcarina* as points from which to start the limiting lines. Of the accessory sulci within this area I have at the moment nothing to say.

The left hemisphere, Fig. III, shows a typical arrangement of the sulci bounding this lobe. On the right side the arrangement is similar, but the *sulcus parieto-occipitalis* does not show on the dorsal surface and hence there is nothing to match that sulcus on the left side. On the right, also, the whole occipital region is smaller as shown by the principle outlines, and just laterad of the most caudal end of the *sulcus occipitalis anterior* is a small group of very shallow sulci which appear hardly deeper than vascular grooves, but which section of the region shows to be true sulci.

The smaller size of the region on the right side and the peculiar sulci just mentioned are the principal points which suggest defective development, as the failure of the *sulcus parieto-occipitalis* to appear on the dorsal surface is not so uncommon in normal individuals. At the same time the fact that this same sulcus is well developed on the left side while it is poorly developed on the right is suggestive when taken in connection with the defects already noted. The gyri of this region are all rather narrow and closely pressed together, thus rendering the intra-lobar sulci inconspicuous. Eberstaller

([24]–No. 19) notes that the length of the arc from the occipital pole to the point where the *sulcus parieto-occipitalis* cuts the edge of the mantel is to the entire arc, *i. e.*, to the *trigonum olfactorium* (see p. 315), as 1 to 6. Measured on the left side in Laura it is 1 to 6.1, and on the right it is 1 to 6. This for our purpose is not so significant as the arc between the caudal end of the *fissura calcarina* and the point where the *sulcus parieto-occipitalis* cuts the edge of the mantel, which is,

On the left side,	50 mm.
On the right side,	29 mm.

Showing the great reduction in that measurement of the *cuneus* on the right side. Further, whereas the arc of the *præcuneus* and that of the *cuneus* are about the same length on the left side—a condition of things which is normal,—on the right side that of the *præcuneus* is much longer than that of the *cuneus*. These relations are shown in Fig. IV, where, as can be seen, one cause of the reduction in size of the *cuneus* is its apparent displacement dorsad of the *fissura calcarina*. In the left *cuneus* I find nothing peculiar to describe. In the right side the *sulcus parieto-occipitalis* may be considered to branch just below the letter *p*. The *ramus* marked *p.o.* runs dorsad towards the edge of the mantel, but never reaches the dorsal surface, as the bounding gyrus has its concavity ventrad and its convexity dorsad. The other branch, running almost vertically in Fig. IV, appears to unite with the *sulcus* which, lying cephalad to the *sulcus parieto-occipitalis*, represents that described by Eberstaller([24]–No. 18) as a branch of the interparietal, and by Wilder([28]) as the cephalic stipe of his *fissura paroccipitalis*. The union is apparent only, and is caused by the extension caudad, in the form of an operculum, of the præcuneal wall that bounds these sulci. On removing this operculum, the *sulcus parieto-occipitalis* is seen to be represented by the sulcus marked *p. o.* alone and to have undergone something of a bend with the concavity caudad, at the point of apparent branching, but the relations with the *fissura calcarina* are normal. The appearance here is somewhat further complicated by a considerable development of the accessory sulci on the mesal surface. So far as we have gone, therefore, the right *cuneus* is less well developed than

the left. It will be recalled that we also found the posterior *cornu* of the left side in better condition than on the right. From these facts it appears that the right occipital lobe shows several anomalies which when all are taken together indicate that the arrest of development has been more marked on this side. It will be remembered that up to her seventh year Laura was somewhat sensitive to light in her right eye while she was completely blind in the left. That sensitiveness meant the preservation of a certain portion of the retina in the right eye for some five years longer than in the left. The conservative value for the nerve centres of even such weak stimuli has long been recognized, and it is but natural therefore that the occipital lobe chiefly connected with the right eye should be better preserved than the other whose development was presumptively arrested earlier and during the years most important for growth.

Temporal Lobe.—This is disproportionately small and alike on both sides. The failure to develop appears to affect most of all the tip. In Laura's case I have not discovered anything that seemed to deserve study as an anomaly, so far as the gross anatomy of this region is concerned, and I can present nothing on the cortical centre for hearing, on the assumption that that centre is in or about the first and second temporal gyri [Horsley and Schäfer([40]), Starr([41])]. It may be that the defects in the sense of smell and taste have left their mark on the uncinate gyrus and its neighborhood, if Ferrier's([39]) localization is accepted; but it must be remembered that neither of these senses was entirely wanting, although the former was very defective. I should hesitate, however, to adduce any direct evidence from our case.

While searching for defects it is only fair to keep in mind that the centres for those senses and activities which Laura did retain might have undergone an unusual development. Nevertheless, her finger dexterity in talking would not, I should think, call for unusual control from the cortex and the refinement of touch in her case appears to have been limited to the hands and face. The portion corresponding to the finger and thumb area (see Mills [42—p. 290]) is fairly devel-

oped on the left side and not quite so well on the right, but there is nothing in the gross appearance that is remarkable. Since the interesting work of France([58]) on the *gyrus fornicatus* and the association of this with dermal sensibility in monkeys, I was led to examine this region with such care as the poor condition of this part of the specimen would permit, but with negative results.

Measurements of Cortical Areas.

Every now and then during the present century various investigators have made the attempt to get at the quantity of gray matter in the cerebral cortex, both in man and some of the animals. It has thus far proved impossible to obtain a figure for this portion of the brain which would have the accuracy, for example, of those we possess for its weight, but several approximations have been made which are of some value. The questions which such an examination was designed to answer have not always been briefly formulated and it will be as well to state at once what we expect from it in this case. We wish to know whether those portions of the cortex, which in Laura we suspect are defective and which belong to one hemisphere, will prove to have a less area, when the two hemispheres are compared with one another. We wish to know further whether the total area of the cortex is, in our case, less than the total area of the cortex in a normal brain with which that of Laura might be compared. In the statements just made the term area has been alone used, but of course if we knew at the same time the average thickness of the cortex, then the masses of the cortex might as easily be compared as the areas. These measurements are for the most part neglected in the usual description of specimens, as it takes some time and trouble to make them, and the results are perhaps not proportionate to the expenditure of energy necessary for this. Nevertheless when we get them all together there is quite an array of figures to be found in the literature.

With a view to rendering these results intelligible I shall briefly present some of the objects and conclusions of investigators in this line. R. Wagner([31]) made a number of direct

measurements of the area of the convex (as distinguished from the mesal) surface of specimens in the famous Göttingen collection, which contained among others the brains of Gauss, Fuchs and Dirichlet. He was followed by his son, H. Wagner(“), who measured not only the entire exposed surface but also the length and depth of the sulci, from which the sunken surface, *i. e.*, the portion forming the walls of the sulci, could be calculated, and from these two results the total area of the cortex was obtained. In carrying this task to completion H. Wagner established several relations between portions of the cortex which subsequent investigation has tended to confirm. The main problems which the Wagners had in mind were: first, whether individuals of superior intelligence had the frontal lobes unusually developed; and second, whether, if the individuals were arranged in series according to intelligence, the figures for the areas of the cortex of the respective brains would follow the same order. To the first question the answer was negative; to the second, apparently positive. At the same time the brains of the more intelligent individuals in their series were in general heavier *i. e.* larger than those of the less intelligent and their table might as well be interpreted to mean that in general the larger brains have the larger cortical areas. From the data given by H. Wagner(“) I form the following table to illustrate this last point:—

	Weight of Cerebral Hemispheres, Fresh.	After Hardening in Alcohol.	Total Area of Cortex.
Gauss,	1492 grm.	957 grm.	219588. sq. mm.
Fuchs,	1499 grm.	895 grm.	221005. sq. mm.
Frau,	1185 grm.	864 grm.	204115. sq. mm.
Krebs,	1273 grm.	771 grm.	187672. sq. mm.

It may be noted in passing that Table VIII of H. Wagner (“) is the one that appears in the text books where the figures for the area of the cortex are given. The total area in the original table is expressed as the sum of the areas of the frontal, parietal, occipital and temporal lobes. As a matter of fact it is the sum of these plus the area of the *insula (Stammlappen)*, but the figures for the *insula* have been omitted in the printing of the original table. It thus happens that the figures representing the total area are somewhat larger than the sum of those for the separate lobes as given

in the table. This omission in the original has been perpetuated by the text-books, but so far as I know attention has not previously been directed to it.

Most directly in the line of Wagner's work is that of Jensen(45) who measured the area of the cortex on six brains of the insane with a view to finding whether they exhibited any peculiarities in this respect. His results were negative.

There are two points in this connection which I desire to emphasize. First, the authors who have undertaken this sort of work have at the same time realized that the thickness, structure and nutrition of the cortex were factors entirely left out of account, and probably of the greatest importance; and second, we have thus far complete measurements only on brains hardened in alcohol in which a decrease in weight of 27%—40% has taken place and consequently no results are at hand to determine by this method the area of the cortex in the fresh normal brain.

Vogt(46) in his study of microcephalics has given the areas of the exposed surface of the brains. These measurements, however, were taken not on the specimens, but on the casts of the cranial cavity. Of the other methods that of Baillarger(47) is the most direct, though not the most satisfactory. He separated the cortical surface in the fresh specimen by dissecting out the white matter from the hemispheres. This made it possible to unfold the cortex and thus get at the area by direct measurement. His figure for the total cortical area of the hemispheres is 170000 sq. mm. which he thinks may be correct within 7% for his cases. Besides these there are methods which may be designated respectively as the geometrical, physical and chemical. In a certain sense the measurements of the Wagners and Jensen were geometrical as the cortical surface sunken in the sulci was calculated from the observed length and depth of the sulci. Calori(48) reduced the exposed surface of the hemispheres to geometrical forms and measured them in that shape, using the device already described for getting the area of the sunken cortex. Giacomini is of the opinion that Calori's method is less exact than that of the Wagners and Jensen. The specimens had been hardened in alcohol. His problem was the varia-

tion in the total area according to the shape of the head. The results which Calori has obtained from a very large number, 41, of Italian brains, measured by his method, are indicated by the following average figures :

Male :	Brachycephalic,	243773 sq. mm.
Male :	Dolicocephalic,	230212 sq. mm.
Female :	Brachycephalic,	211701 sq. mm.
Female :	Dolicocephalic,	198210 sq. mm.

The physical method of getting at similar results is based on the weight of the entire brain, its specific gravity and the specific gravity of the gray and white matter that compose it. This method has been introduced by Danilewsky(49). The result is the percentage of gray and white matter in a given specimen. If now a certain proportion of the gray matter is assumed to belong to the cortex we can obtain the mass of the cortex and in turn assuming a certain average thickness for the same we can calculate the area. Omitting all detail, Danilewsky(49) found :

For encephalon weighing 1240 grm., total cortical surface, 158800 sq. mm.
" " " 1324 " " " " 169200 " "

As will be seen these figures fall below any that have thus far been given.

In the chemical method, so called, the percentage of water is determined instead of the specific gravity and from data thus obtained the mass or area of the cortex can be determined. More or less complete data for the percentage of water in the gray and white matter of the brain have been furnished by Bourgoin(50), Desprez(51) and Forster(52). Giacomini takes the view that of the last two methods the chemical one is the more exact. At his suggestion DeRegibus(17—p. 276), examined several brains and obtained the following figures for the area of the cortex :

1.	Single hemisphere,	128000 sq. mm.
2.	Both hemispheres,	278940 sq. mm.
3.	" "	245160 sq. mm.
4.	" "	217472 sq. mm.

The original weights of the brains are not given.

The figures obtained by Baillarger(47) and by those authors who have used the physical and chemical methods apply to the fresh brain, having its normal size ; whereas all the other figures apply to brains shrunken by alcohol. At the moment

we have no means of making the corrections required, but it would be fair to expect that measurement on the fresh brain would show a larger area than those on alcoholic brains. If that is a true inference, then it is not a little curious that of these authors just mentioned only DeRegibus presents figures which are at all comparable with those of the Wagners, Jensen and Calori, the figures from the other observers being smaller.

I pass now to the measurements of our own specimen. The questions to be answered have already been stated: 1st. To determine any differences between the areas of special regions in the two hemispheres. 2nd. The total area of the cortex.

Method of Making Measurements. Investigators have covered the exposed surface of the cortex with squared paper, tin foil, gold-leaf or something of the sort, and then by computing the number of these squares required to cover a given region have calculated the area. In this instance I moistened thin sheets of gelatine until they were flexible; these were then laid on the surface and the outlines of the exposed portions of the gyri traced on them by means of India ink. The area of a region having thus been transferred to the gelatine it was removed, a copy of it taken on tracing paper and numbered. The same area was enclosed by a line on the plaster cast and given the same number, thus each region was recorded. The gelatine sheet was placed over a piece of standard paper ruled in squares 2 mm. on each side. Under a lens magnifying 6 diameters the number of squares enclosed by the outline was enumerated and reduced to millimeters. The method proved quite practicable and accurate. In getting the area from the gelatine sheet measurements were made to square millimeters.

The length of the sulci was taken with compasses where that was permissible, but usually with a strip of tin foil marked in centimeters. The fractions of a centimeter were taken with compasses and read on a millimeter scale. The depth of the sulci was taken with a fine hard rubber probe, a trifle enlarged at the tip so that it had there a diameter of 1.3 mm. On this a button of pith which slipped easily served to mark the dis-

tance to which the probe was inserted, and this distance was read off on a millimeter scale. The majority of the sulci were sounded every centimeter, short ones at lesser intervals. The calculations of the sunken surface were made on the assumption that the lines representing the length and depth formed with one another rectangular figures. Jensen's(*) argument for considering these figures zonal segments, on the convex surface at least, was at the time unknown to me, but I think that the error introduced by the method used has in our case largely balanced out, since the direct measurement of the depth of the sulci was constantly too small. The figures were not summed until all the data were collected and they have not been manipulated in any way save as I shall in a moment state. The sums thus obtained are as shown in Table I.

TABLE I.

Total Surface, Sunken and Exposed. (Not corrected.)

	Left.	Right.
Insula,	1760. sq. mm.	2026.5 sq. mm.
Frontal lobe,	27624.5 sq. mm.	29584. sq. mm.
Occipital lobe,	3824.5 sq. mm.	3604.8 sq. mm.
Residual portions,	51056.7 sq. mm.	47452. sq. mm.
	84265.7 sq. mm.	82667.3 sq. mm.
Absolute difference =	1398.4 sq. mm.	
In percentage =	1.8 %	

As will be seen the result shows the total cortical surface nearly alike in both hemispheres.

By "exposed surface" is meant that portion which does *not* contribute to the walls of the sulci; by "sunken surface" that which does thus contribute. The portion of the *insula* and the *operculum* which would, under this definition, be called exposed is nevertheless counted as part of the sunken surface from its position, both in the calculations for the surface of the frontal lobe and for the entire hemisphere. In the tables for the *insula* alone a distinction is made between the sunken surface, as defined, and the other portion, which to avoid ambiguity is there called "convex surface." The total figure for the sunken surface of the frontal lobe or a hemisphere contains, then, the not-sunken or convex surface of the *insula* and also the *operculum* which, by the way,

showed no sulci so far as it was in contact with the *insula*. As neither of these contribute to form the walls of sulci they are subtracted from the total "sunken surface" before the average depth of the sulci is calculated. Further, in getting the average depth of the sulci, proper correction is made for those instances where the sulcus had been considered to have but one wall, as in the case of the callosal and the cephalic portions of the Sylvian fissures.

The Sylvian fissure is considered to start at the lateral end of the *vallecula Sylvii*. The limitation of the *insula* is by the *sulcus circularis* (Schwalbe). The frontal lobe is limited by the *fissura Sylvii*, the *fissura centralis*, and the *fissura subfrontalis* (Eberstaller). The limitations of the occipital lobe have been previously described as formed by the *sulcus parieto-occipitalis*, *fissura calcarina*, *sulcus occipitalis lateralis*, and *sulcus occipitalis anterior*.

Finally with regard to the corrections in the figures obtained by direct measurement. Such correction has been made for the depth of the sulci only. This affects in the results, of course, the average depth of the sulci, the area of the sunken surface and the total area. The correction has been made by adding 25% to the observed depth of the sulci, that is, the observed depths were considered to represent 75% of their real value, and were increased so as to represent 100%.

A word of explanation is here needed. The facilities for getting the true depth of the sulci in a brain hardened in potassium bichromate are much less than in the case where the hardening has been effected by alcohol. Sulci in our case could not be opened up without fear of injury to the specimen and the resistance by which one inferred that the bottom of the sulcus had been reached was often caused by the approximation of the walls at some distance above the bottom. This error was neglected, however, until the measurements were complete, on the assumption that it would be the same for both sides. The figures obtained, Table I, justified this assumption and what we have to say concerning the relative development of the hemispheres and their sub-divisions can be equally as well based on the original as on the corrected figures; but when

we desire to compare the total area in our case with that found by other investigators as well as the relations of the exposed and sunken surface, it is absolutely necessary to use the corrected figures. The correction was obtained by measuring sulci in sections of the hemispheres and noting the difference between the true depth and the depth as obtained by the probe. This difference approximated on an average 25%, being a trifle over that figure. It is with regret that I introduce this modification of the results, but certain it is that without the correction the absolute figures would have fallen far below the truth. One point more; we are dealing here with a brain that has swollen in hardening. What the total amount of variation in the area of surface thus produced is, I cannot say, but I see no reason to think that the relations of regions at the surface of the brain have been altered. The portions which did not harden and therefore did not swell were the ental ones, but the cortex throughout was exposed to the action of the fluid in much the same way and does not, I believe, show any distortion that is due to irregularities in the preservation.

Insula.

I may be permitted to state here that the descriptions of the various regions were written before the following figures relating to them had been tabulated, and that in comparing the figures with the previous description I am comparing independent observations.

Defective development of the centre for articulate speech in the left hemisphere has been already described. When defective development occurs here the *insula* is often reported as sharing in the defect. The following, Table II, shows the relations for the *insula*. This table, as well as all those that follow, is corrected in the manner above mentioned.

TABLE II.

Insula. (Corrected.)

	LEFT.	RIGHT.
Greatest length,	55. mm.	66. mm.
Greatest width,	30. mm.	33. mm.
Convex surface,	1488. sq. mm.	1625.5 sq. mm.
Sunken surface,	363. sq. mm.	548. sq. mm.
Total length of sulci,	88. mm.	83. mm.
Average depth of sulci,	2.0 mm.	3.3 mm.

It appears from this that the left insula is less well developed than the right in every way except the length of the sulci, in which it is slightly superior.

Frontal Lobe.

Next in order we take the frontal lobe as above defined.

The frontal lobe is bounded by sulci, and these stand in the table as limiting sulci. One half the sunken surface which lines these sulci is designated as the limiting sunken surface; the other half of course belongs to the lobes bounding the frontal lobe. The area bounded by these limiting sulci is the included area. In this case our interest is in the included area.

TABLE III.

Frontal Lobe. (Corrected.)

	LEFT.	RIGHT.
Total exposed surface,	11320. sq. mm.	12326. sq. mm.
Limiting sunken surface,	5920.4 sq. mm.	5020.2 sq. mm.
Included sunken surface,	15818.4 sq. mm.	17994. sq. mm.
Length of limiting sulci,	449. mm.	411. mm.
Length of included sulci,	1051. mm.	1117. mm.
Average depth of limiting sulci,	13.0 mm.	12.1 mm.
Average depth of included sulci,	7.4 mm.	8. mm.

Considering the included area and the figures relating to it, we find the left lobe inferior to the right in every point; to this inferiority the suspected *gyrus frontalis inferior* is assumed to contribute largely. It would seem simpler to compare measurements of this gyrus on both sides, but the difficulty of bounding it *cephalo-ventrally* has deterred me from trying to make the comparison. The deficiency in the figures relating to the limiting portions on the right side is in part due to the less elaborate development of the *fissura subfrontalis* (Eberstaller)—the *sulcus calloso-marginalis* of Ecker.

Occipital Lobe.

In the earlier description it was brought out that the right occipital lobe and especially the right *cuneus* were poorly developed. Table IV shows the results of measurements.

TABLE IV.

Occipital Lobe. (Corrected.)

	LEFT.	RIGHT.
Total exposed surface,	1660.5 sq. mm.	1302. sq. mm.
Exposed surface of cuneus,	608. sq. mm.	412. sq. mm.
Limiting sunken surface,	1957.2 sq. mm.	1847.7 sq. mm.
Included sunken surface,	928. sq. mm.	1356. sq. mm.
Length of limiting sulci,	133. mm.	137. mm.
Length of included sulci,	108. mm.	116. mm.
Average depth of limiting sulci,	14.6 mm.	13.4 mm.
Average depth of included sulci,	4.2 mm.	5.7 mm.

Here again the measurements support to some extent the previous observations. The total exposed surface, and the exposed surface of the *cuneus* are both less on the right side. But when we come to compare the included sunken surfaces on the two sides the right is superior, and if we sum the total exposed and sunken surface for the two sides we find it:

On Left Side.	On Right Side.
2588.5 sq. mm.	2658. sq. mm.

That is, it results to the advantage of the right side. The disturbance then which caused the peculiarities of the right lobe did not materially alter the cortical development on the two sides. This would, for one thing lead us to regard the *cuneus* where the difference between the two sides is striking with especial care. As the table shows, the exposed surface of the *cuneus* on the left side is the greater. If we add to each exposed surface the sunken surface for this special region, *i. e.*, *cuneus*, we get the following:

	LEFT.	RIGHT.
Exposed surface, cuneus,	608 sq. mm.	412 sq. mm.
Sunken surface, cuneus,	376 sq. mm.	428 sq. mm.
Total surface, cuneus,	984 sq. mm.	840 sq. mm.

This indicates the total cuneal surface as smaller for the more irregular right side, which is what we might expect if the visual centre is here located. For the rest of the occipital lobe there appears to have been that compensatory growth by which the portions about the *cuneus* developed more generously as the *cuneus*, itself somewhat arrested, offered less resistance to their expansion.

Residual Portion.

What remains after the *insula*, frontal and occipital lobes have been considered, I call the "residual portion." In itself

it has no special interest for us at the moment. The figures are given in Table V.

TABLE V.

Residual Portion. (Corrected.)

	Left.	Right.
Total exposed surface,	18842. sq. mm.	19037.2 sq. mm.
Limiting sunken surface,	7877.6 sq. mm.	6867.9 sq. mm.
Included sunken surface,	35074.9 sq. mm.	31022. sq. mm.
Length of limiting sulci,	582. mm.	548. mm.
Length of included sulci,	1619. mm.	1613. mm.
Average depth of limiting sulci,	13.3 mm.	12.4 mm.
Average depth of included sulci,	10.8 mm.	10. mm.

Having thus presented the data for all portions of the hemispheres it remains to cast them in the form of tables so that, as far as possible, they may be compared with the results of others, and we may thus determine something of the relative cortical development in this case. Table VI gives the total exposed surface according to the limitations previously stated.

TABLE VI.

Total Exposed Surface.

	Left.	Right.
Insula,		
Frontal lobe,	11320. sq. mm.	12326. sq. mm.
Occipital lobe,	1660.5 sq. mm.	1302. sq. mm.
Residual portion,	18842. sq. mm.	19037.2 sq. mm.
Total,	31822.5 sq. mm.	32665.2 sq. mm.
Absolute difference,		842.7 sq. mm.
Percentage difference,		2.6 %

Table VII gives in the same way the total sunken surface.

TABLE VII.

Total Sunken Surface. (Corrected.)

	Left.	Right.
* Insula,	1851.0 sq. mm.	2173.5 sq. mm.
Frontal lobe,	21738.8 sq. mm.	23014.2 sq. mm.
Occipital lobe,	2885.2 sq. mm.	3203.7 sq. mm.
Residual portion,	42952.5 sq. mm.	37889.9 sq. mm.
	69427.5 sq. mm.	66181.3 sq. mm.
Absolute difference,	3246.2 sq. mm.	
Percentage difference,	4.9 %	

* It will be recalled that for our purpose the *insula* is not considered to have an exposed surface.

TABLE VIII.

Total Surface, Sunken and Exposed. (Corrected.)

	LEFT.	RIGHT.
Insula,	1851.0 sq. mm.	2173.5 sq. mm.
Frontal lobe,	33058.0 sq. mm.	35340.2 sq. mm.
Occipital lobe,	4551.7 sq. mm.	4505.7 sq. mm.
Residual portion,	61794.5 sq. mm.	56927.1 sq. mm.
Total,	101256.0 sq. mm.	98946.5 sq. mm.
Absolute difference,	2309.5 sq. mm.	
Percentage difference,	2.3 %	

This Table VIII gives the total figures which I consider final for this specimen. To prevent any possible misunderstanding I may state again that Table I, which gives the original figures before they were corrected, is presented to show on what basis the corrections were to be made. And though it is possible that the two tables may be confused, I hope by this explicit statement to prevent such a complication, and make it plain that Table VIII only is the one to be used in comparison with the figures obtained by other authors.

In connection with Table VIII, I have to call attention to the figures for the total surface of the *insula* and frontal lobes of the left side which still remain smaller, whereas the occipital lobe is slightly larger on the left side. On the whole the area of the left hemisphere is greater, and I associate that with the fuller development of the caudal portions of this hemisphere. (See Fig. III.)

The length of sulci is shown in Table IX, and as will be seen the left hemisphere is a trifle inferior in this measurement. The limiting sulci are of course counted but once, so that if their length is given for the frontal and occipital lobes then the residual portion is to be credited with the included sulci only.

TABLE IX.

Total Length of Sulci.

	LEFT.	RIGHT.
Insula,	88 mm.	83 mm.
Frontal lobe, limiting sulci,	449 mm.	411 mm.
Frontal lobe, included sulci,	1051 mm.	1117 mm.
Occipital lobe, limiting sulci,	133 mm.	137 mm.
Occipital lobe, included sulci,	108 mm.	116 mm.
Residual portion, included sulci,	1619 mm.	1613 mm.
	3448 mm.	3477 mm.

Table X exhibits the average depth of the sulci for each hemisphere. The average depth of the sulci is obtained in the following manner: From the total sunken surface as previously given, the areas of the *operculum* and convex surface of the *insula* are subtracted. The areas for the *sulcus callosi* and the portion of the *gyrus frontalis inferior* which forms the dorsal wall of the *fissura Sylvii*, which have not been doubled in estimating the sunken surface, are added to this remainder. The sum is then divided by two, thus giving the area of one side of all the sulci. This divided by the total length of sulci gives the average depth. This process is carried out in Table X.

TABLE X.

Average Depth of Sulci. (Corrected.)

	LEFT.	RIGHT.
Total sunken surface,	69427.5 sq. mm.	66181.3 sq. mm.
Less sum of opercular and convex insular surfaces,	2426.0	2663.
	67001.5 sq. mm.	63518.3 sq. mm.
Plus callosal wall	1037.0 sq. mm.	1037.0 sq. mm.
Plus dorsal wall fiss. Syl.	827.0 sq. mm.	400.0 sq. mm.
One-half of this total	68865.5 sq. mm.	64955.3 sq. mm.
equals	34432.7 sq. mm.	32477.6 sq. mm.
Dividing this last figure by	3448.	3477.
Gives average depth of Sulci	9.9 mm.	9.3 mm.

The table explains itself I think without further comment, except the difference between the figures for the dorsal wall of the *fissura Sylvii* on the two sides, which is due to the fact that the method of measurement was not the same in both cases.

Before we make comparison of those figures which apply to the entire hemispheres, several other numerical relations may be noted. The surface of the frontal lobe in per cent. of the total surface is found to be:

	LEFT.	RIGHT.
Total surface,	100	100
Frontal lobe, total surface,*	32.5	35.8

We may also express the relations of the exposed and sunken surface in the two hemispheres:

*Our limits of the frontal lobe enclose a smaller region than those of the other authors who have given figures.

	Left.	Right.
If total exposed surface =	1.	1.
Then total sunken surface =	2.18	2.02

This relation of the exposed to the sunken surface is that which has been found by others, namely, the sunken surface is on the average very slightly more than twice the exposed surface.

Finally H. Wagner(44) devised a formula by which the exposed surface of the brain could be calculated from its several diameters. Applying this formula to our specimen we find by calculation a figure which is some 25% larger than that obtained by observation. Evidently the swelling of the brain and the consequent gaping of the sulci renders this formula inapplicable in our case.

It remains now to determine what peculiarities these figures obtained from our specimen show when compared with the figures from other authors, always keeping in mind that the latter figures used for comparison were obtained from shrunken specimens, whereas ours is swollen. We shall use for comparison the data furnished by H. Wagner(44), Jensen(45) and Calori(46). From the first the figures for the "woman" are used. From the second those for "Rockel," female, insane, and from the last those for brachycephalic females, three in number.

TABLE XI.

Total Surface.

Weight of Fresh Encephalon.	Left.	Right.	Sum.
1204 grm. Laura,	101256. sq. mm.	98946.5 sq. mm.	200202.5 sq. mm.
*1304 grm. Woman,	102742. sq. mm.	102373. sq. mm.	205115.0 sq. mm.
1065 grm. Rockel (female, insane),	74615. sq. mm.	74523. sq. mm.	149138.0 sq. mm.
1236 grm. Brachycephalic females.			245260. sq. mm.
1151 grm. Brachycephalic females.			195684. sq. mm.
1056 grm. Brachycephalic females.			194160. sq. mm.

The total figure for Laura, though her brain is swollen, is somewhat under that found by Wagner, and also under the average taken from the two brains of Calori with which it may be fairly compared, but above that of Jensen. The

* Figures for area corrected from H. Wagner's(44) table. As I understand Wagner, the fresh weight of this brain, which he gives as 1185 grm., applies to the hemispheres alone. 1304 is the estimated weight of the entire encephalon to which these hemispheres belonged.

small brain weight and the mental condition of the patient in Jensen's case must however be considered. I see here no greater variation than occurs in the full tables of these authors. We may conclude therefore that the total area of Laura's brain, if at all peculiar, was small for its weight. Comparison for total length of sulci and their average depth can be made only with the first two, as Calori does not give his figures on this point.

TABLE XII.

Total Length of Sulci and Average Depth.

Name.	Left.		Right.		Sum.	
	Length.	Av. Depth.	Length.	Av. Depth.	Length.	Av Depth.
Laura,	3448. mm.	9.9 mm.	3477. mm.	9.1 mm.	6625. mm.	9.5 mm.
Woman,	3349. mm.	9.88 mm.	3189. mm.	10.48 mm.	6538. mm.	10.14 mm.
Rockel,	2870. mm.	——	2834. mm.	——	5704. mm.	9.08 mm.

It appears that, whereas the length of the sulci is greater in Laura than in those with whom she is compared, the average depth in less than that of the woman and more than that of Rockel. At the same time both length and depth are well within the limits found by these authors for other brains.

The relative development of the frontal lobe is something to which a certain historical value, at least, attaches. The frontal lobe as we define it is somewhat smaller than that of Wagner and Jensen as they include that portion of the *gyrus fornicatus* which extends caudad as far as the *præcuneus*. If we include this region so as to make our results comparable with theirs we have the figures given in the next table.

TABLE XIII.

Relative Development of Frontal Lobe, given in Percentage of the Total Surface.

	Left.	Right.	Average for Both Hemispheres.
Laura,	36.8	39.9	38.3
Woman,	40.	41.	41.
Rockel,	38.3	40.9	39.6

When the comparison is made in this way Laura is seen to be slightly inferior to the other two. An examination of the tables shows this to depend mainly on the smaller average depth of the sulci. The inferiority of the left side is manifested here again. In general then we may say that so far as these measurements are concerned, Laura's brain differs from other brains with which it may be compared to

no remarkable degree, and the difference can in part at least, be explained by the failure of certain portions of the brain to develop completely. The determination of the mass of the cortex must await the measurement of its thickness, and that together with other observations is reserved for a second article.

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Explanation of Plates.

The Figures were drawn from photographs with the aid of a pantograph. Their size is approximately that of the hardened specimen. The lines indicating the sulci represent the middle of the lines marking sulci in the photograph. No indication of the gape of the sulci is given, except in the case of the *fissura Sylvii*. Where the sulcus gapes widely this method of representation makes the gyri on either side appear broad, and it is of course not possible to tell in these figures just how the space between any two sulcal lines is filled. The more constant sulci are indicated by heavy lines. The names are arranged alphabetically according to the initial letter of the abbreviation.

C. Fissura centralis.
Ca. Fissura calcarina.
c'r. Sulcus centralis transversus.
d. Sulcus diagonalis.
f 1. Sulcus frontalis superior.
f 2. Sulcus frontalis inferior.
f 3. Sulcus frontalis medius.
fm 1., *fm 3.* Sulcus fronto-marginalis.
ip. Sulcus interparietalis.
occ. ant. Sulcus occipitalis anterior.
occ. lat. Sulcus occipitalis lateralis.
pci. Sulcus præcentralis inferior.
pcs. Sulcus præcentralis superior.
po. Fissura parieto-occipitalis.
r. Sulcus radiatus.
rtc. i. Sulcus retrocentralis inferior.
rtc. s. Sulcus retrocentralis superior.
rtc. tr. Sulcus retrocentralis transversus.
S 1. Fissura Sylvii.
S 2. Ramus anterior ascendens fissuræ Sylvii.
S 3. Ramus anterior horizontalis fissuræ Sylvii.
S 1. asc. Ramus posterior ascendens fissuræ Sylvii.
sft. Fissura subfrontalis.
t 1. Sulcus temporalis primus.
t 2. Sulcus temporalis secundus.
t 3. Sulcus temporalis tertius.
t 4. Sulcus temporalis quartus.
t 1. asc. Ramus ascendens sulci temporalis primi.
t 2. asc. Ramus ascendens sulci temporalis secundi.
× Points at which the specimen was cut across.

PLATE I.

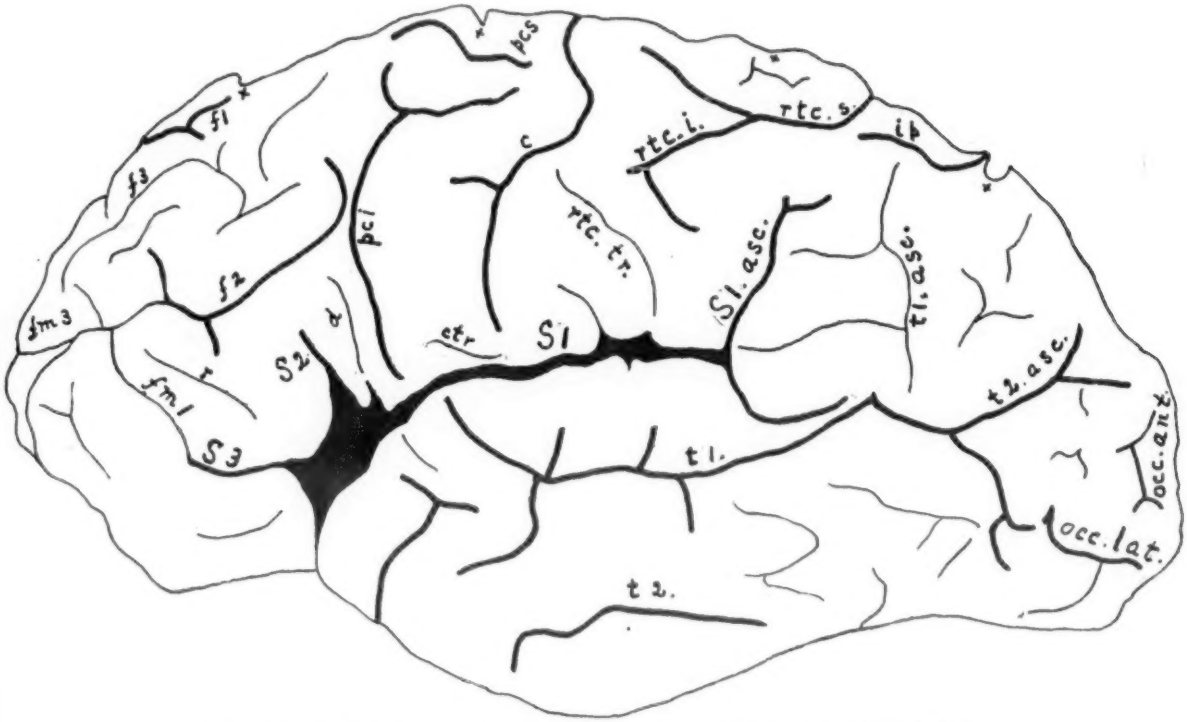


FIG. I. Left hemisphere, seen from the side and somewhat from below.

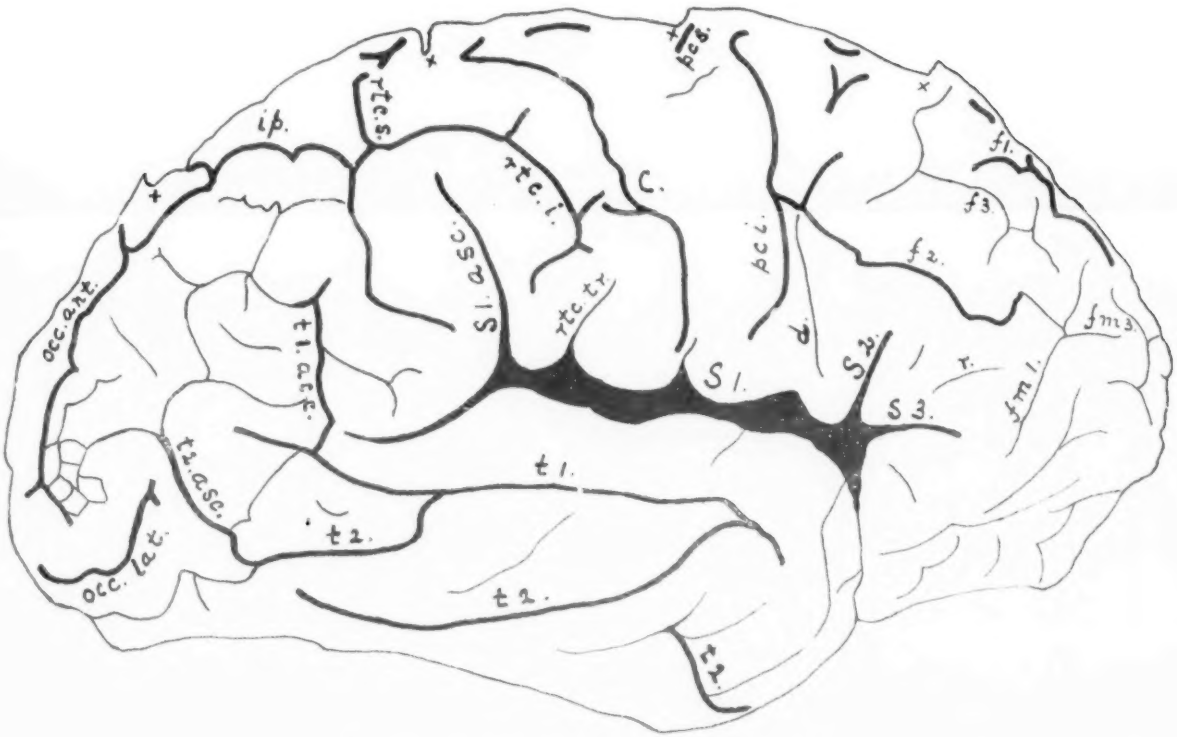
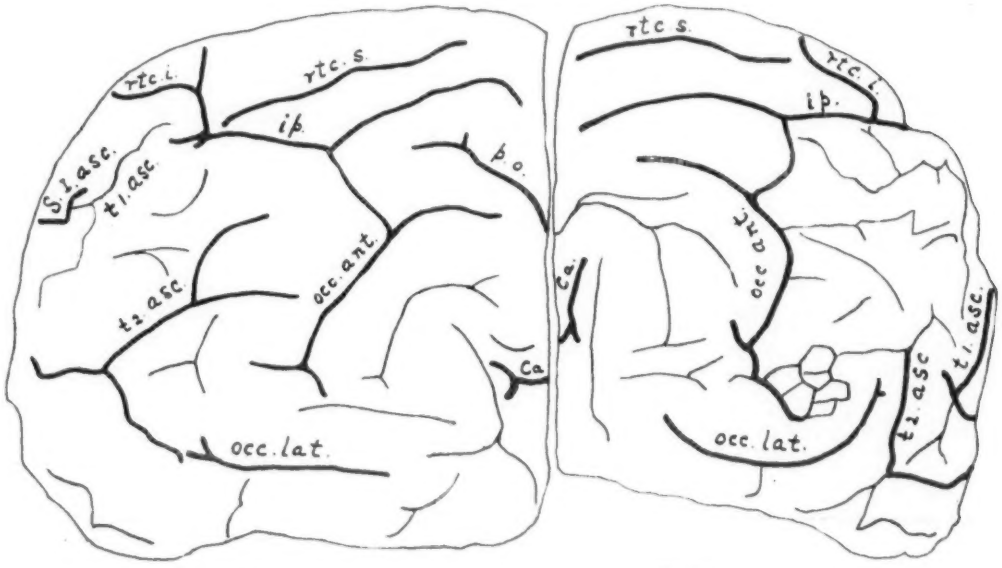


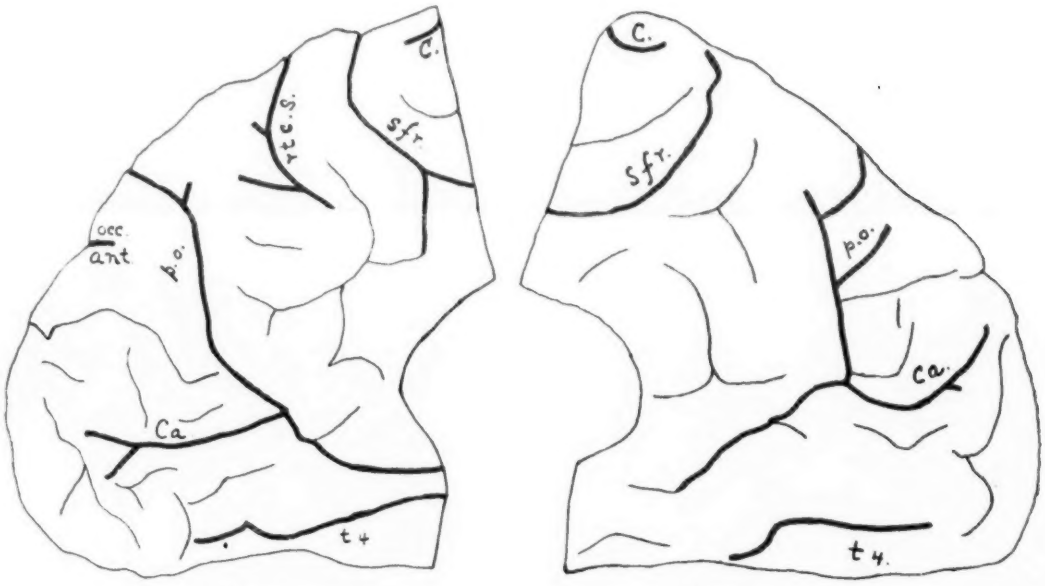
FIG. II. Right hemisphere, seen from the side.

PLATE II.



LEFT. RIGHT.

FIG. III. Both hemispheres seen from behind, showing principally the occipital region. The difference between the hemispheres is exaggerated by the fact that they are viewed rather more from the left side.



LEFT. RIGHT.

FIG. IV. Mesal surface of both hemispheres, to show the region of the cunei and præcunei

A SKETCH OF THE HISTORY OF REFLEX ACTION.

By C. F. Hodge, Ph. D.

II.

Bell's Law.

The modern history of the nervous system may be said to begin with Charles Bell's demonstration of the law which bears his name; *viz.*, that the *posterior roots of the spinal nerves are sensory, the anterior motor.* Bell justly complained that the anatomists of his day had become disheartened by the seemingly irregular and lawless complexity of neural fibres. To those who know least of the actual anatomy of the parts, Bell says, the prevailing theories seem most ample and satisfactory; while those who study deepest only discover error and confusion. No wonder they had recourse to the authority of the ancients. Haller declared, as Galen had done, that the same nerve which conducted sensation also carried motion. But on any of the theories then extant, how the same little nerve could carry a motor impulse one way and a sensory impulse the opposite way at the same time was a confusing puzzle. Bichat (1771—1802) had distinguished the sympathetic, (or as he mistakenly called it, the ganglion system,) which presided over the functions of organic life, mediated sympathies between various parts of the body, was comparatively insensitive, and not directly under the control of the will, from the cerebro-spinal system. Curiously enough in 1809 Alexander Walker, a Scotch anatomist, claimed to have proved the converse of Bell's Law; *viz.*, that the posterior roots were motor and the anterior sensory.

Bell was accused of dissecting brains to find the seat of the soul; and this he denies in his first work upon the subject,[1]

[1] Charles Bell: Idea of a new anatomy of the brain. Submitted for the observation of his friends. Lond., 1811. The copy to which I had access is a transcription "made by H. U. D., 1813," in the possession of Dr. H. H. Donaldson.

saying that his only wish is to investigate the structure of the brain as we examine the structure of the eye or ear. Nowhere in this paper is the Law formally stated. But from it is seen that Bell is deeply imbued with the ideas which underlie, not only his Law, but the physiology of the nervous system as it is now understood. "The nerves of motion, the nerves of sensation and the vital nerves," he says, "are distinct throughout their whole course" (op. cit. p. 7). "The nerves which we trace in the body are not single nerves possessing various powers, but bundles of different nerves whose filaments are united for convenience in distribution; but which are distinct in office as they are in origin from the brain" (op. cit. p. 6). As is well known, Bell outlines the theory of specific energy of nerves. "An impression," he says (op. cit. p. 11), "made on two different nerves of sense, though with the same instrument will produce two distinct sensations, and the ideas resulting will have relation to the organs affected. Piercing the retina with a cataract needle gives a flash of light, and a blow on the head makes the ears ring and the eye flashes light, but no sound or light are present." The effect depends upon the part of the brain excited. Penetrated with these conceptions Bell sought to answer intelligently the following questions: 1, Do the nerves of the trunk and limbs derive the ability to perform their functions from a combination of peculiar forces received from the different parts of the cord indicated by their double roots? 2, Is this the reason why their course is simple or isolated as compared with the cerebral nerves? 3, Which nerves of the head and face correspond in structure with those of the trunk? Bell was acquainted with the sensory and motor effect of irritating the anterior and posterior columns respectively. On this point he says (op. cit. p. 26), "I found that injury done to the anterior portion of the spinal marrow convulsed the animal more certainly than injury done to the posterior portion." Thence he was lead to observe a corresponding difference of function for the roots. He continues (op. cit. p. 27), "On laying bare the roots of the spinal nerves, I found that I could cut across the *posterior fasciculus* of nerves, which takes its origin from the

posterior portion of the spinal marrow, without convulsing the muscles of the back; but that on touching the *anterior fasciculus* with the point of the knife the muscles of the back were immediately convulsed."

In a later paper[1] Bell lays down the principle that complexity of nervous supply to an organ indicates a corresponding complexity of function. An organ with but a single nerve has but one function to perform; while the tongue, for which he observed five distinct sources of nervous supply, was employed in as many ways. For a voluntary muscle he asserted the existence of a double nervous supply, a *nervous circle*, one arc of which transmitted the excitement of the brain to the muscle, the other carried the sensation of the muscle to the brain. The proof of this he sought in the fifth nerve where besides direct fibres to the muscle there are also fibres which enter the muscle after passing the ganglion of Gasseri. The latter must be sensory nerves according to a fundamental principle which he had laid down, that no motor nerve was ever interrupted between its origin and its peripheral end by ganglia. All nerves, he admits, may be divided into these two classes, sensory and motor, but in view of the division in function and for convenience sake he prefers to make a separate class for the "respiratory nerves," *i. e.*, the nerves which co-ordinate the muscles for respiration, expression of emotion, etc. It was the investigation of this class which led Bell to his great work upon the nerves of the face and chest, and this in turn brought to light many facts in support of his Law. As has been shown, he performed experiments upon living animals to demonstrate his Law to his own satisfaction, but his aversion to vivisection and his predilection for anatomical methods no doubt delayed a full comprehension of the scope of his discovery; but an extended collection of faithful observations confirmed it beyond all doubt, and he boldly asserted its validity for each of the thirty-one pairs of nerves in man, as well as for all forms of lower vertebrates.[2]

[1] Charles Bell: On the Nerves; giving an account of some experiments on their structure and function which lead to a new arrangement of the system. Phil. Trans., 1821. pp. 398—424.

[2] See, Charles Bell: The Nervous System of the Human Body; embracing the papers delivered to the Royal Society on the Subject of the Nerves. R. S. London, 1830.

From studying the effects of cutting the facial and then the maxillary nerve in asses and monkeys Magendie (1783—1855) was led to sever anterior and posterior spinal roots, and declared that he had at last established by direct experiments the difference between sensory, or posterior, and anterior, or motor, fibres. In examining the body of a patient who had lost all power in his arms while sensation in them remained intact, he found the anterior roots considerably decayed. This law he found to be valid along the entire length of the cord, from which Legallois had already proved the motor and sensory powers of all organs without exception to be derived, one part of its surface being exquisitely sensitive and another part motor. It might thus be expected, Magendie declared, that as we pass from the surface to the centre of the cord we should reach a "secret sanctuary" where sensation perhaps passes into motion. This, however, is not the case, for, as he says, touching the centre of the cord causes neither sensation nor motion.[1]

This paper of Magendie[2] was published as an entirely independent and original observation and the claim of priority in the discovery of the law in question was at once made for him. While it seems on the whole probable that his method of demonstration was more conclusive than that of Bell, there is little doubt that the latter deserves to be called the discoverer. From other earlier papers of Bell it appears that, although not clearly recognizing the principles he finally established, he was penetrated with the idea that the difference of neural functions was grounded in anatomical differences;[3] and there is little doubt that Bell's results, which his assistant went to Paris in 1821 to demonstrate on the facial nerve, had been seen by Magendie. To him, however, belongs

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[1] Magendie: Sur quelques découvertes récentes relatives aux fonctions du systeme nerveux. Annales de chimie et de physique. Vol. 23, p. 429. Paris, 1823.

[2] Magendie: Leçons sur la Physiologie. Paris, 1839.

[3] For a good digest of Bell's earlier opinions, see *Karl Bell's Darstellung der Nerven; frei bearbeitet von Dr. H. Robbi mit einer Vorrede von I. C. Rosenmüller.* Leipzig, 1820.

the merit of introducing what was first established as an anatomical and pathological law into the fruitful field of physiology.[1]

Bell's discovery at once excited the liveliest discussion on the continent. Many doubted the validity or at least the universality of the Law. Of those who were convinced of its truth, some raised the further inquiry as to how the sensory and motor roots were distributed peripherally. The greater number of investigators, however, were led to study the functions of the various columns of the spinal cord to ascertain how far the distinction of sensory and motor could be traced in it. Bellingeri distinguished three pairs of columns in the spinal cord. The anterior pair were connected with the cerebrum, the posterior pair with the cerebellum. The lateral, restiform, and pre-eminently ganglionated columns mediated organic and instinctive functions. The anterior roots were composed of fibres from each of these columns. So too were the posterior roots. Those fibres of the anterior roots which sprung from the anterior columns mediated voluntary motions, and the fibres of the posterior columns which sprung from the posterior horns of the grey substance were exclusively sensory. All fibres, of which root soever, that took their rise from the posterior cerebellum columns innervated extension muscles, and those from the anterior columns innervated the flexors. For this latter conception he found fanciful ground in the phenomena of *episthotonus* and *emprosthotonus*.

Schoeps, in 1827, concluded that motility required more nerve-force than sensibility, and that the former was more impaired by section of the anterior root than by section of the

[1] Charles Bell. Nervous System of the Human Body. A note in explanation of this point states that "in Dec. of 1821, Mr. Shaw wrote a paper on the facial nerves in *Brandis' Journal of Science*. In this he stated, that at the request of M. Magendie he had repeated Mr. Bell's experiments on the face of a horse at Charenton, near Paris, and had at the same time presented to M. Magendie a copy of the Manual above mentioned (Manual of Anatomy; Explaining Mr. Bell's System; by John Shaw). * * * * It was after all this (in July, 1822) that M. Magendie published his paper on the nerves of the spine. On its arrival in this country, M. Magendie was informed that these experiments had been performed in Great Windmill Street, which he acknowledged in his next Journal, with the addition, that, although Mr. Bell had preceded him, his own proofs were more complete."

posterior, because the latter was feebler, smaller, and not generally able alone to move a limb. He grants that there is more mobility in the anterior columns and roots, and more sensibility in the posterior, but concludes from his experiments adversely to Bell's assertion of a complete division of function. Becker, in 1830, vindicated an absolute division of function, upon experimental and pathological grounds. Langenbeck, however, the following year, thought Bell's Law as speculative as Gall's localization of cerebral functions. As the activity of the brain may involve the functions of the entire mass, so the cord may be motor or sensory throughout. The fact that the anterior and posterior columns are so intimately connected, and the two halves of the cord are interlinked by so many commissural fibres, made a division of functions seem improbable. The fibres of both roots, moreover, are so intricately interwoven, after leaving the cord, in the plexus that the integrity of each of the two systems seems impossible. Experimental objections were urged only against Bell's assertion that the facial is exclusively a motor, and the trigeminus a sensory nerve.

Much light was thrown upon the matter in the first volume of Müller's *Physiologie*, in 1834. He may be said to have established Bell's Law in Germany. One reason why previous observers had found such difficulty and reached such conflicting results in their investigations was that most of them had used warm blooded animals, the nerves of which, especially of the posterior roots, speedily lose their power and die in consequence of the necessary operations. Another reason was that many of them had not clearly distinguished between reflex and direct stimulation, nor between the results of stimulating the peripheral or the central end of the sensory root. Müller used frogs, the large accessible and persistently vital nerves of which make them especially fitted for such studies, and he compared the effects of stimulating the severed peripheral ends of each root. Any clear distinction between anterior and posterior columns, either anatomically or functionally, Müller discountenanced; still more so the idea that the outer or white substance mediated motion and the grey central substance sensation. He was moreover inclined to regard the

spinal cord as the common collective bundle of all the trunk nerves, rather than as a part of the central organ. Bell's theory, though ingenious, he thought had not been hitherto satisfactorily proved. His own method established it with a simplicity and certainty not inferior to that of the best physical *experimentum crucis*. These results were confirmed by applying galvanic irritations to both roots. Panizza and Van Deen confirmed Bell's Law by new and manifold experiments.[1] The last sought to determine which parts were innervated by the single nerves, and concluded that the seventh pair of the frog mediated the movement of flexing the thigh against the belly, the eighth, all the movements of the hip and knee, and the ninth pair of nerves the movement of the foot and toes. He inferred that in the plexus sensory and motor nerves cross and intertwine without losing or interchanging their functions. The use of the plexus according to Van Deen was to be found in the fact that different movements which traverse it at the same time are easier and more harmonious. The position, connection, and form of the muscles was determined by the position and form of the plexus. The peripheral ending of sensory nerves is in the skin, that of the motor nerves in the muscles. The two can be compared with the veins and arteries which often run side by side, but the motions mediated by each are in opposite directions and they communicate directly with each other. The nerves like the muscles of the two halves of the body are symmetrical and unconnected save in the higher nerve centres. Here the ends of sensory and motor nerves lie near together in order that the latter may observe the behests of the former. Longet, whose investigations were published in 1841, thought galvanism peculiarly adapted to demonstrate Bell's Law on higher mammals. He severed the anterior roots of one leg leaving the posterior roots intact, and even after administering small doses of strychnine observed no motion upon that side while the other was violently convulsed. The galvanic current was applied directly to the strands of the cord with

[1] For a brief sketch of the work of these and several other investigators, see J. W. Arnold: Ueber die Verrichtung der Wurzeln der Rückenmarks Nerven. Heidelberg, 1844.

many interesting results which were, however, largely vitiated from the same cause that led him to suspect the results of his predecessors, *viz.*, that the currents used were too strong. An anonymous writer, who accepted the fact that section of anterior and posterior roots destroyed motion and sensation respectively, still protested against the presupposition of Bell's Law that motion and sensation were two distinct functions, because in morbid or abnormal conditions they seemed to be more or less isolated.[1] "There are points in the nervous system," he says, "where sensation and motion pass over into each other; it is one and the same soul that feels and moves, while if Bell were right two souls, one sensory and another motor, would be conceivable. Nothing can be more casual and external than the merely spacial distinctions between anterior and posterior, and yet the re-iteration of this distinction is all Bell's school have accomplished, and this is made essential in the nature of the soul. Instead of interpenetration of functions necessary to true psychic unity, Bell offers a mechanical juxtaposition and agglomeration, which encourages speculative anatomy and is no less unscientific and disintegrating than phrenology or a supposable theory that muscles have flexor and extensor fibres." He concludes that our soul would be much poorer than it is in feeling and action, if motor nerves did not conduct centripetally and inform us of the condition of our muscles and if sensory nerves did not lead outwardly.

III.

The Physical Versus the Psychic Theory of Reflex Action.

The labors of Bell, Magendie and Johannes Müller had made known in a practical way the anatomical elements concerned in reflex action; *viz.*, a centripetal and a centrifugal nerve with their portion of the spinal cord. Anatomy out of the way, the next question was one of physiology, namely, do these parts operate upon mechanical principles or not? That the mere transmission of an impulse along a nerve is purely

[1] Roser und Wunderlich's Archiv. Jahrg. I. S. 295.

mechanical can hardly be doubted, but what of the central process by which a sensory is changed to a motor impulse, and so directed as to cause definite movements of the muscles?

The first to elaborate a mechanical theory of reflex action was Marshall Hall. Besides the cerebral system, which mediated the functions of sensation and volition, and the ganglionic, which presided over the functions of nutrition, he assumed a third, *viz.*, the true spinal system. This last he describes as follows: "The spinal cord of vertebrates consists of two parts very closely connected with each other, not easily separable anatomically, and perhaps only to be distinguished by physiological and pathological methods.[1] The first part is a bundle of nerves which subserve the purpose of sensation and volition. The central organ for these fibres is the brain, from which they proceed and to which they return. The second part, which may be designated as the true spinal cord is distinguished by the excito-motor nerves. Generally, though perhaps not invariably, it is connected with the former system." The answer to the question how far excitory nerves can be separated or distinguished from sensory and motor nerves from voluntary, he assumed must be sought in invertebrates, which lead an excito-motor life with little sensation or volition, because in them the nerves need not be clustered into bundles in passing out from the spinal cavity between two vertebræ. He regarded the opticus and acusticus as purely sensory, without excitory functions. The tonicity of muscles he considered as the result of excito-motor force, mediated by motor nerves which are enclosed in the same sheath as the volitional nerves, and observed that this power is active in sleep in all muscles except the *levator palpebrae* and perhaps the *recti*. Hence he concludes that the nerves which innervate these are purely volitional without motor power. This opinion, however, is not put forth with great confidence and still less is he disposed to insist upon the existence of purely excitory nerves. He regarded, however, the pneumogastric as the least sensory

[1] See his writings *passim*, but especially his Memoirs on the Nervous System. London 1837. Translated into German by G. Kürschner, Marburg, 1840; p. 50 of the Ger. edit.

and the most excitory of all nerves among the vertebrates. But, although the anatomical distinction between these systems may be questioned, the action of narcotics, the movements of decapitated animals, cases of paralysis and all convulsive diseases, on which he made many observations, warrant the inference, not only of an independent system, but even of two roots in every sensory-excitory and in every volitional-motor fibre, one ending in the cord, the other in the brain. The excito-motor system never sleeps, but constantly watches day and night, with great, though not absolute independence from the brain, over all the openings of the body, eyes, nostrils, mouth, larynx, and all the sexual and excretory passages. There is *nothing whatever that can be called psychic connected with any of its activities*, and Marshall Hall assured his readers with much complacency that all the complexly co-ordinate and seemingly purposive movements made by the brainless animals he so long and diligently studied, snakes, tritons, frogs, cats, dogs, rabbits and leeches, etc., are unattended by sensation or by any other *rudimentary form of consciousness even in the least degree*. If the head of an eel be first removed, the trunk may be skinned without the "abominable cruelty" of the ordinary practice, for then all its writhings are purely mechanical. Formerly, he reminds us, irritability or the *vis in sita* of muscles was thought to be sensory-volitional, and he claims for himself the merit of distinguishing it from excito-motor action. The vital functions die in the following order: first the sensory-volitional, located in the brain; then the respiratory, centered in the *medulla oblongata;* then the excito-motor or reflex; and lastly muscular irritability, of which *rigor mortis* is the "last act." Lethargy may be so deep as to affect even the lowest of these functions. The embryo in its development reverses this order, and the fœtus before birth is only irritable and reflex. Hall was well acquainted with the works of his contemporaries in France and Germany, and identified excito-motor power with Haller's "*vis nervosa*," Müller's "*motor-power*," and Flourens "*excitability*." He accepted the law of isolated conductivity of nerve fibres, but believed spinal motor-power could work in both directions and made observation that reflex contrac-

tions differed from direct in occurring more "gradually" and in being less local.

G. Kürschner, the translator of Hall's treatise into German, wrote a long and suggestive appendix, full of independent and confirmatory observations. His experiments led him to the conclusion that in the spinal cord sensory and motor nerves are distinct from each other, the former composing the posterior, the latter the anterior column. Although separated, both species of fibres are most closely connected with each other, probably through the action of the grey substance. Each group of sensory corresponds to a distinct group of motor-fibres in such a way that in different parts of the cord, one and the same sensory group is connected with several motor groups, and hence it is that every spot of the skin, *e. g.*, corresponds to certain motions of the muscles.[1] Thus he infers that perhaps all possible combinations of muscular motions may be preformed in the structure of the cord and the *medulla oblongata*, and that the sensory nerves of the external surface of the body are connected with combinations which cause single motions and change of place, while those connected with the inner mucous surface occasion so called organic reactions. When brain and cord were destroyed gradually downward, Kürschner believed that the manifoldness and complexity of the body or of any single limb were gradually lost before the sum of its mobility was sensibly affected. Müller had assumed that the striking difference observed between the action of the muscles of the "animal" system and those of the "organic," as they were then called, was due to the difference in the mode of innervations, while Kürschner argued that it was due to differences of texture and structure in the two classes of muscles, and showed that the same irritation to heart, intestines and voluntary muscles gave in each case the characteristic sort of contraction produced by normal innervation. Kürschner believed that the activity of the ganglia incited motion "as water drives a mill," while the cord, besides exciting action, at the same time prescribed its forms. Single movements, as flexions, extensions, etc., he believed

[1] Kürschner; Uebersetzung von M. Hall, appendix, p. 216.

were reflexly combined in the cord; the "single motions, of which every part of the body is capable," are co-ordinated in the *medulla oblongata*, while the movements of the limbs are combined into co-ordinated movement within the cerebellum. Kürschner, however, agrees with Müller that Hall's hypothesis of a complete and special excito-motor system is untenable, and thinks we might as well accept Stilling's argument that there are special nerves for the sensations of heat and cold.

The theory of Marshall Hall at once excited interest, especially in Germany, where it has led to many fruitful investigations, and provoked many controversies. Rudolph Wagner declared it a mere hypothesis, while Henle asserted that all grey substance acts reflexly. Dupré rejected the hypothesis of a special excito-motor system and assumed that reflex functions are mediated by peculiar communicating fibres in the cord. Budd distinguished two species of reflexes, one centered in the brain and attended by sensation, and another in the cord, unattended by sensation. Many observations were made to determine the truth of Hall's statement that brainless animals never moved spontaneously; while the peculiar psychological turn which the discussion often took shows how far metaphysical conceptions had pervaded even the medical profession.

While the French society for the study of condemned criminals achieved very little for science, a single careful experiment by Bischoff and two of his colleagues, though attended with only negative results, deserves mention. The head and body of a freshly decapitated murderer were placed by the authorities at his disposal. Objects were thrust toward the eyes, the word "pardon" was shouted into the ear, a strong tincture of assafœtida was held before the nose, but all absolutely without result. Slight and repeated movements of the jaw and tongue followed the application of collodion to the latter. Spirits of wine produced the same effect. These movements, however, were thought to be due neither to sensation nor reflex action, but to irritation of the severed ends of nerve-fibres in the spinal cord. All these observations were made within less than one minute from the fall of the execu-

tioner's sword. The features were calm and natural as in life, only the eye-lids were partially closed and the pupil slightly dilated. There was also reason to believe that he was perfectly conscious at the moment of the fatal blow. The eye-lids, lashes, conjunctiva, mucus membrane of the nose, mouth, and throat were next touched. A needle was thrust into the central end of the severed cord, which was also touched with a caustic substance, all within the next one or two minutes, but no further movements whatever were observed, indicating that the nerves had ceased to be irritable and that consciousness was extinct. The severed carotid arteries of the body were tied up as soon as possible, and about half an hour after the blow, it was irritated in various ways and places, but, although direct application of electricity caused contraction in various muscles, there were no signs of reflex functions.[1]

Volkmann who had previously expressed the belief that the cord had sensory functions,[2] was led later to change this opinion, and to write, after recapitulating Hall's argument, as follows: "Strictly considered, however, such experiments prove only that that part of the body furnished with the brain, does not feel the irritation of that part which has been severed from its connection with the brain. But whether the isolated cord does not have sensations of its own, obscure though they be, is not manifest. In lower animals the sensitive principle is unquestionably divisable; whether anything analogous can be assumed for higher animals, can scarcely be decided. All through the history of psychic development, sensation necessarily precedes volition, so that a sensitive organism without voluntary motion is easily conceivable. Yet an observer of another organism can infer the existence of sensation only from the play of voluntary motion. Hence although the latter ceases with decapitation, sensation itself is not necessarily lost; its demonstrability becomes impossible. Impossible as it is to prove that decapitated vertebrates are insensible, still we are unable to assume for them the power of sensation. At any rate we have no occasion to conceive consciousness as divisible in the higher animals, and, as

[1] Bischoff, Müller's Archiv, 1838, p. 489 ff.
[2] Müller's Archiv, 1838, p. 15 ff.

above explained, we can assume the power of sensation to exist only where the perceptions of nerves of sense become the possession of consciousness."[1] Volkmann does not regard the brain of the lower animals as exclusively the organ of the soul. Of animals which have the cord and *medulla oblongata* intact, Volkmann says, their movements cannot be called reflex. "Rather the entire behaviour of animals so mutilated is so characteristically psychic that we have no tenable ground to deny the co-operation of the psychic principle. It only seems doubtful to me what height of development the soul can reach with so small an amount of brain matter. I consider it probable that the condition of the soul in such cases is dream-like. Sensations are certainly perceived, only they must be more obtuse and very limited after the removal of the specific organ of sensation. Obscure conceptions (*Vorstellungen*) seem also to be present with which the first efforts of the animal are connected and from which again movements proceed. Such movements do not rise indeed to the full freedom of volition; and just as little do they sink to the mechanism of reflexes."[2]

Later Volkmann opposes Marshall Hall's assumption of a spinal excito-motor system; for upon this theory not only must the number of specific fibres be increased to an impossible extent, but the fact cannot be explained that stimulation of a single sensory fibre may excite a very few motor fibres or a vast number, or in fact, all the motor nerves in the body.[3]

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[1] Wagner's Handwörterbuch, Bd. I, 1842, p. 576.

[2] A. W. Volkmann, article, Gehirn, Wagner's Handwörterbuch der Physiologie, Vol. I, 1842, p. 582. The precise status of the debate is well shown by the experiment to which Volkmann here appeals. A frog, from which he had just removed forebrain, cerebellum and optic lobes, was placed in a shallow dish of water and lay motionless and apparently dead for half an hour. At the end of this time, it raised its head as if for breath, and after a while began of its own accord to swim, making the motions at first clumsily and afterwards with more precision. The movements here could in no sense be called reflex (Volkmann supposed), because they do not begin as stimuli at the skin which are carried to the spinal cord and thence reflected into the muscles; the action was only outward; it began spontaneously in the cord. But the entire absence of external stimuli is difficult to prove, and in this case venosity of the blood and contact with the water are wholly neglected.

[3] Volkmann, Nerven Physiologie, in Wagner's Handwörterbuch, Vol. II, p. 546-7, 1844.

Hall had made some explanation of how the sensory irritation passed through the cord in being reflected outward into motor nerves; but he does not himself attach much weight to this point.[1] Grainger thought he found in each spinal root a portion which turned upward toward the brain and another portion which buried itself immediately in the cord. Spies, carrying the fallacy a step further, assumed a direct connection of excito-motor fibres with each other in the cord. To all this Volkmann objected on the ground of too great complexity, and argues at considerable length for the hypothesis of a transmission of irritation from one nerve fibre to another.[2] This may occur for all nerves, in the cord, in plexi, in the ganglia, and in the brain; while the law of isolated conductivity holds for the peripheral nerves. Not only is reflex action thus explained, but all sympathetic movements and sensations and even *delirium traumaticum*, where a painful wound causes delirium without fever. Even indistinct vision and a defective musical ear are perhaps due to the transition of the irritation from the nerve previously affected to the others which lie near it; and we learn to distinguish fine motions and tones probably by learning to isolate the action of nerves. In fatigues which are painful the state of the motor nerves springs over to the sensory, and in this way the normal association of movement may sometimes be explained. The removal of the brain or the inhibition of its action in sleep increases the facility of such transitions in the cord; while attention sometimes causes more perfectly isolated conductivity of the fibers. Nerve activities which are naturally isolated may become combined by habit and training and may be re-isolated by disuse. The excitation of many fibres may in this way sometimes be concentrated upon one point.

The claim for priority in formulating the excito-motor

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[1] Marshall Hall, New Memoirs on the Nervous System, pp. 37-38, London 1843. After calling it the "questio maxime vexata" among writers upon reflex action, he adds with reference to separate volitional-sensory and excito-motor fibres: "nothing of the kind has ever been proved; the two distinct orders of fibres have not been divided or irritated distinctly."

[2] Wagner, op. cit. p. 528, et seq.

hypothesis was made for Johannes Müller. But he himself repudiates this and shows that his view is quite distinct from that of Marshall Hall, and in many respects it must be admitted to be the more consequent of the two.[1]

Müller maintained that it is by no means necessary that sensation should always attend reflex action. "According to my opinion," he says, "the stimulation of a sensory spinal nerve causes a centripetal action of the nerve principle, which reaches the cord. If this can pass on to the *sensorium commune*, it becomes a conscious sensation. But if, on account of section of the spinal cord, it cannot reach the sensorium, it expends its entire force as a centripetal action upon the cord. In both cases reflex movements may result, in the first instance attended by conscious sensation, in the second, not."

As many German physiologists since have done, Müller rejected Hall's hypothesis of specific excito-motor fibres.

Pflüger began his able, but somewhat violently polemic, work by declaring in his preface that consciousness is motion, and has no being. As such it is a part of the great life of the world. Consciousness exists only where central nerve substance is found. It is extended in space and by whatever name it is called, whether sensorium or soul, it is divisible in all animals with its material substratum. After a short discussion of other views, recognizing especially Whytt, Prochaska and Legallois as his predecessors, he proceeds to develop as follows his well known theory of a "spinal cord soul."

Reflex action Pflüger defines to be the operation of that neuro-physic mechanism, by means of which the peripheral sensory fibre, by whatever cause excited, alters through the mediation of the spinal cord, the ordinary state of excitation of definite motor nerves.[2]

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[1] Müller, Handbuch, Vol. I, p. 622. See also Du Bois-Reymond. Gedächtniss Rede auf Johannes Müller; in Abhandl. d. k. Akad. d. Wissensch., zu Berlin, 1859.

[2] Pflüger, Die sensorischen Functionen des Rückenmarks. Berlin, 1853, p. 62. This work also contains valuable references to the earlier literature relating to this question.

The change thus caused in motor nerves may be of such a nature as to effect the shortening of the muscles, giving us a reflex contraction or reflex cramp; or it may cause the muscle to relax, resulting in the phenomenon of reflex inhibition or paralysis. These processes, he remarks, must be widely distinguished from those of sympathetic or irradiated sensations. These latter have been explained by some as occurring in the spinal ganglia, which act as imperfect conductors and arrest weak excitations, while stronger impulses spring over and stimulate neighboring fibres and are reflected outward according to the law of isolated conduction. This, however, is not sufficient, for sympathetic sensations arise in nerves which pass no ganglia, *e. g.* nasal tingling from looking at the sun, and in those which enter the cord remote from each other.

Reflex action, Pflüger believed, could be best studied in men and so, after searching through a great number of cases of reflex neurosis from German, French and English pathological literature, he was led to his well known laws of reflex action, which he states as follows:

I. Law of Unilateral Reflexes.—*If peripheral stimulation causes contraction in only one half of the body, the contraction always occurs on the same side as the stimulus, and in general those muscles contract whose nerves arise from that segment of the cord, to which the irritated sensory nerve belongs.*

II. Law of Reflex Symmetry.—*If the effects of stimulating a sensory nerve upon one side extend to the other side, only such motor fibres are called into activity as correspond with those which are already excited on the side of the stimulation.*

III. Law of Unequal Contraction on the two sides.—*If the contraction is unequal on the two sides, the stronger reflex is always on the side of the stimulation.*

IV. Law of Reflex Irradiation.—*1. When stimulation of a cerebral nerve causes reflex contractions, the motor nerve concerned is invariably either in the same level as the sensory nerve, or it is further downward toward the medulla oblongata. 2. When stimulation of a spinal nerve causes*

reflex contractions beyond its own segment, irradiation always takes place toward the medulla oblongata.

In the former case the nerve stimulated may be a nerve of special sense; thus for example, an irritation of the optic nerve is reflected outward along the oculo-motor.

V. THE LAW OF THE THREE LOCATIONS OF REFLEX CONTRACTIONS.—*Upon stimulation of a sensory nerve, reflexes can occur in only three parts of the body.* These are: *a.* at the level of the stimulated nerve; *b.* in parts innervated from the *medulla oblongata; c.* in the whole body.

After citing pathological cases illustrating these laws in full, Pflüger describes his own experiments. By the first law the trunks of eels, fish or salamanders (which move in but two directions), if separated from the brain and irritated on one side, *e. g.* by a candle flame, should be drawn directly towards the side irritated and thus fully into the fire. He found, however, the opposite always the case. Even a small end of the tail was reflected away from the fire. But if the animal had been put under the influence of strychnine, its tail followed the law and reacted into the flame. This difference he infers to be due to the presence of a rudimentary consciousness in the former case.[1] Exactly similar results were obtained from young kittens in which the spinal cord had been divided in the dorsal region. The whole subject, however, may best be studied in the frog. When the skin of a decapitated frog is pinched in the middle of the belly, both feet strive to push the hand or tweezers away, while if the same place be touched with acid the reaction consists in rubbing the irritated spot. If one side be irritated and the leg of the irritated side be severed, the other leg is slowly brought around to remove the irritating object.

Finally Pflüger urges[2] that if the brain were the only organ of sensation, all sensory fibres must go to it and that after section of the cord an irritation of the upper surface of the section would cause sensation which by the law of eccentric projection would seem to be located in all parts of the

[1] Op. cit. p. 112 ff.
[2] Op. cit. p. 130 ff.

body below the section, while an irritation of its lower surface would cause contraction of all the voluntary muscles below the section. The fact is, however, that if the upper part of the cord be injured the sensation of pain is located not in the legs, but in a band around the body. While if the cord be gradually destroyed from above downward, instead of motions of all the parts at once, the muscles of the arms, breast, belly, thigh, etc., are successively stimulated. These facts go to prove that both motor and sensory nerves end in their respective levels of the spinal cord and not in the brain, which so many would make the sole organ of sensation and volition. The brain Pflüger regards as a reservoir of motor forces. By its instrumentality sensations can be compared, and expressed verbally and otherwise, while the cord can respond only by moving. Even motion, however, is probably not a certain index of the presence of the dull, undifferentiated sensations, which are assumed in the cord and which, it would seem, must rise above a certain threshold, before motion can follow. In the reflexes during sleep, Pflüger also observed that if the nostrils of a sleeping child be tickled and the hand on that side gently held, the other hand is brought to the irritated point, and he expressed the belief that none of the functions of the sensorium, extended through the cerebro-spinal system, are suspended during sleep, but that sensorial activity is reduced uniformly throughout.

The bitterness and arrogance of Pflüger's style is in strange contrast to the calm, impersonal tone of Lotze's argument and reply. Lotze, it should be premised, had previously urged that reflexes, and perhaps the lower forms of instinct, are purely mechanical.[1] Nature, he says, must lead the soul by the hand a little way into the strange land of space and matter. For each stimulus that breaks upon it from the outer world, a mechanism must be furnished ready made to its use which shall respond with an appropriate movement, or the impulse to it (p. 194.) By this means, nature shows the immaterial, unspatial soul, by purely physical connections,

[1] Lotze. Instinct. Wagner's Handwörterbuch der Physiol., Vol. II, p. 191.

what purposive movements to make. After the soul learns these elementary motions, it weaves them in ever richer and more complicated patterns; but, these elements themselves, it can neither invent nor construct. They are like the letters of the alphabet or elementary sounds, which must be first learned, and which reason may then combine in countless ways into words and sentences, but does not alter in form or number.

The argument particularly addressed to Pflüger and those who agreed with him starts from the general assumption that the motor states of the soul, transformed in the brain alone into physical changes of matter, are propagated in this new form through the centrifugal nerves to cause contractions of the muscles. And conversely, physical changes set up in the peripheral ends of sensory nerves are conducted unaltered in character to the brain, where occur all those processes by which physical excitation is transformed into the psychic form of sensation, a feeling.[1] After repeating Pflügers experiments with the decapitated frog, which, when one foot was amputated, used the other to remove the acid, and the eel's tail which reacted from, instead of into, the flame, Lotze calls these movements not only teleological, but at the same time adapted to the special circumstances of the stimulus. And he pronounces them not due to intelligence or sensation present in the cord, but to the *after effects* of these. Acts of the conscious will, he says, leave behind "not only unconscious recollections, but also physical impressions in the organs of the central nervous system," and these latter, as well as the soul itself are sufficient to account for Pflüger's phenomena. States which can be first caused only by consciousness may actively persist as conditions of a substance after consciousness has vanished. By practice and training a secondary character, which survives decapitation, is thus imparted to subordinate centres, ennobling the already complex apparatus by the possession of new associations between sensation and motion.[2] Pflüger, he continues, might have argued a limitless series of

[1] Lotze. Göttingen gelehrte Anzeiger. 1853, III, p. 1737 ff.

[2] This notion of Lotze's has received corroboration in the experiments of Steiner, reviewed in the last number of this JOURNAL, Vol. III, No. 2, (1890.), p. 187, middle of the page.

souls for all, even the smallest, function and part of the body; each soul stimulated to greater, though we know not what, activity by severing it from its superior centre. All this we must reject as incompatible with the unity of the individual soul. In the light of this conception Lotze attempted to explain in detail Plüger's Laws of the phenomena and found his crucial experiments too uncertain to sanction the inferences drawn from them.

But once more the argument swings to the other extreme, and this time with the weight of Auerbach's[1] authority. Auerbach repeated Pflüger's experiments, he tells us, on more than three hundred frogs and many eels, pikes, tritons, snakes, lizards and rabbits, and reaches the conclusion that psychic force may be set free in any part of the brain or spinal cord. Hence the integrity of consciousness suffers, if the central nervous system is injured. It is difficult to see, however, wherein Auerbach carried the argument beyond the point at which Pflüger left it. He nowhere even reaches the level of Lotze's view.

With Lotze we do advance in thought a step beyond the comparatively crude, simple, mechanism of Marshall Hall to a mechanism of the utmost delicacy, a mechanism susceptible of the nicest adjustments, capable of education, and of prolonged, independent and complex activity. And why is it, queries Lotze,[2] that the whole world bristles up the moment the fact of mechanism in psychology is mentioned? Men seem to think that the soul loses something of its dignity and that the highest moral interests are endangered, if we do not attach to the smallest details of life the full operation of free will. "This is the dogma of the schools." On the other hand how much of our education is directed to the very end of making the daily round of life mechanical? Habit, as people term it, is only another name for mechanism.

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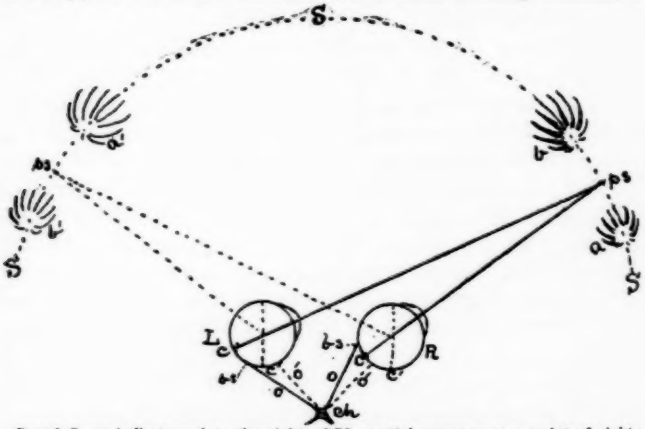
[1] Auerbach. Günsburg's Zeitschrift für klin. Med. 1855. pp. 452—96.
[2] Wagner's Handwörterbuch, Lotze, op. cit. p. 200.

MINOR CONTRIBUTIONS.

ON A CURIOUS VISUAL PHENOMENON.

By Prof. Joseph LeConte.

For some years past I have observed a visual phenomenon which is so conspicuous and even brilliant, that it seems almost incredible that it should have escaped the attention of Physiologists; and yet I do not remember to have seen it mentioned. If it has been already discussed, I should be glad to have my attention called to the fact.[1] The phenomenon of which I speak, however, cannot be observed except when the retina is exceptionally sensitive, *i. e.* after sleeping, and especially on waking up in the morning. I have tried in vain to observe the least sign of it during the ordinary course of the day, or when the retina is in the usual waking condition.



R and *L*, eyeballs turned to the right; *SSS*, spatial concave; *p s*, point of sight; *a* and *b*, circles of bright rays; *o o*, optic nerves; *ch*., chiasm; *b s*, blind spots; *c c*, central spots. The dotted lines and primed letters = optic axes, lines of sight, optic nerves, central spots, etc., in other positions of the eyes.

[1]Since writing the above, Pres. Hall has called my attention to the fact that the phenomenon is noticed by Helmholtz, (*Optique physiologique*, p. 268). But I find the description insufficient and the visual appearance somewhat different from that in my own case.

If on first waking up in the morning, the lids be closed, and the eyes be turned strongly to one side or the other, as if to look at a point on the extreme verge of the visual field, two brilliant circles of radiating lines, surrounding each a blank space, are momentarily seen, one on each side of the point of sight. On turning the eyes strongly in the opposite direction, they again flash out of the dark field on the other side at the moment of extreme strain of the ocular muscles.

The figure represents the eyes turned strongly to the right and directed to the point of sight, *ps*. The brilliant circles are represented by *a* and *b*. I have tried this experiment hundreds, perhaps thousands, of times, and always with the same result, but on account of the flashing momentariness of the appearance, and still more on account of its occurring at some distance from the point of sight (where only, form is accurately given), it is difficult to make an exact picture. What I have given is very nearly what it seems to me.

Such is the phenomenon—what is the explanation? Every appearance in the visual field is, of course, the representative of a corresponding change in the retina. What is the retinal correspondent in this case? I am quite sure it is the *blind spot* or point of entrance of the optic nerve into the eyeball; or, to be more accurate, the blank space from which the bright rays diverge is the representation of the blind spot, and the circle of bright rays represents the retina immediately surrounding it. The cause of the phenomena is this: when the eyeball is violently turned to one side, there is a corresponding strain or pull on the optic nerve, and, moreover, the optic nerve is strongly bent at the point of entrance into the eyeball. In the figure, the dotted lines *o' o'* represents the position and length of the optic nerves when the optic axes are in primary position, as represented also by dotted lines. In turning the eyes to one side, the optic nerves, as may be seen, are both lengthened and strongly bent. The flash of light is produced by the irritation of the bacillary layer immediately surrounding the point of entrance of the optic nerve.

I have said that there are two bright circles, one on each side of the point of sight, one corresponding to each eye. To which eye does each belong? As is well known, the optic nerves enter the eyeballs in the inside or nasal side of the central spots (see figure). But impressions on the nasal halves of the two retinæ are seen doubled *homonymously*. Therefore, of the two bright circles, the one on the right side (*a*) belongs to the right eye, and the one to the left side (*b*) belongs to the left eye. I have found in my experiments that the left-side one (*b*) in looking right, and the right-side one (*a'*) in looking

left, is the more brilliant. The reason of this is easily explained. For, except in looking at a great distance, with the optic axes parallel, it is evident that in looking right it is the left eye that is more turned and the optic nerve more pulled; and in looking left, the right eye and right optic nerve. But again, it will be observed that the rays are not equal in all directions, but stream, as it were, backward from the direction of ocular motion. In looking right, the rays stream to the left, and in looking left, they stream to the right. Now, since all retinal impressions are reversed in position in the field of view, this means that the retinal impression is greater on the right side of the blind spot, in the first case, and on the left side in the second case. In other words, in both cases the stimulation of the retinal rods is greatest on the side *toward which the optic nerve is bent* by the motion of the ball. The stimulation is probably, therefore, more by *crushing* than by *pulling*.

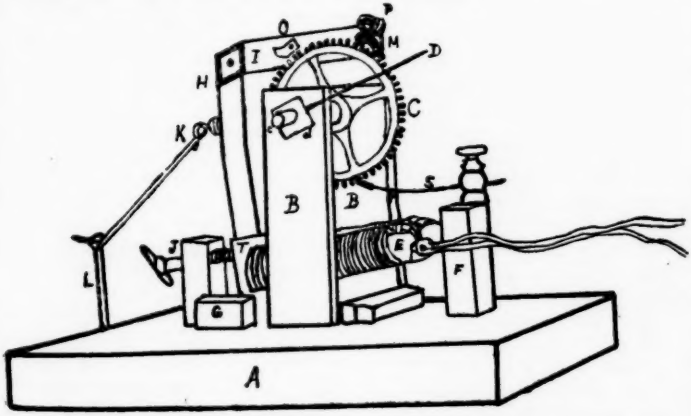
Many attempts have been made to detect some representation of the blind spot in the field of view. In most of these, the expectation seems to have been to find a black spot, or a dark, or dim, or dusky or clouded spot. But such expectation betrays a misconception of the nature of the blind spot. This spot is an *insensitive spot*, and its representative, therefore, is an *invisible spot*, *i. e.*, a spot where objects disappear from view. It cannot be a dark or dusky spot, or a spot of any kind *differentiated from the general field*, for then it would be a *visible spot*, which it is not. As it cannot be differentiated from an even field, like a white wall, or the sky, the *mind* extends the general color of the neighboring field over it. We seek in vain, therefore, to find a visible representation of the blind spot in the field of view. But in the experiment described above, the *place* of the invisible spot, or the spatial representation of the blind spot, is distinctly observed in the dark field. Not that the spot itself is differentiated from the general field, but the parts immediately surrounding the invisible spot are differentiated, both from it and from the general field. We know of no other experiment that brings out clearly the place of this spot.

A COUNTING-ATTACHMENT FOR THE PENDULUM-CHRONOSCOPE.

WILLIAM NOYES, M. D.

In the April number of this JOURNAL Dr. E. C. Sanford described a form of chronoscope in which the principle of the vernier is applied to the exact measurement of time, and the present apparatus is simply an addition to his chronoscope by which the beats of the slower pendulum are recorded mechanically and indicated on a dial. The counting-attachment is simple and inexpensive, and may easily be made without the assistance of a mechanic.

The principle of the apparatus is simply that every time the slower pendulum reaches the middle of its arc it makes an electric circuit (independent of those mentioned by Sanford), sending the current through an electro-magnet which pulls forward the arm of a lever, which in its turn shoves forward a cog of a cog-wheel, on the axis of which is attached a second-hand moving over a dial. When the pendulum swings past its centre the circuit is again broken and a spring pulls the lever back to its original position.



The construction of such an instrument is very simple, and the cost trifling, one dollar being sufficient to cover every-

thing, even if the materials have to be bought new—fifty cents for a small electro-magnet, twenty cents for two binding posts, leaving thirty cents for a cog-wheel and necessary sheet brass and tin. The base of the instrument, *A*, consists of a piece of pine board 7 inches square, and on this are two wooden uprights, *BB*, $3\frac{3}{4}$ inches high, 1 inch wide, $\frac{3}{8}$ of an inch thick, and $2\frac{1}{2}$ inches apart. These support a cog-wheel, *C*, having sixty cogs, which was taken from an old clock. On the axis, *c*, of the wheel is a piece of small wire 2 inches long, serving as a second-hand; the wire is supported by a small wooden nut, *d*, which is made to slip off and on the axis easily, but with sufficient friction to keep it in place. The dial is not shown in the diagram, as it would prevent a view of the working parts of the instrument; it consists simply of a circle of tin $4\frac{1}{2}$ inches in diameter, on which is pasted a piece of white paper divided into 60 minutes, like a clock-face. The second-hand is taken off, the dial put on the axis and tacked to the support, *B*, and the second-hand is then replaced. Care should be taken that the hole in the dial through which the axis passes is so large that there is no friction when the cog-wheel is in motion. Between the upright posts is a small electro-magnet, *E*, $3\frac{1}{4}$ by 2 inches, wired firmly to a wooden base and to a short post, *F*. In front of the poles of the magnet is an armature, *T*, made of soft hoop iron $\frac{1}{16}$ of an inch thick and 2 by $1\frac{1}{4}$ inches in size. To the lower corners of this armature are soldered two pieces of wire running out horizontally, with their ends filed to points which play in small holes in pieces of sheet brass which are fastened to the inner sides of two small wooden supports, only one of which, *G*, is shown in the diagram. To the soft iron armature is soldered an upright piece of sheet-brass, *H*, 1 by 4 inches in size, with an arm, *I*, also of brass extending alongside the cog-wheel. The extent of the movement of the armature is regulated by the screw, *J*, passing through a small wooden post, and having on its inner end a piece of rubber against which the armature is drawn back by the spring, *K*, the tension of which is regulated by raising or lowering the pin, *L* (a $2\frac{1}{4}$ inch brad), which passes into a binding post not shown in the diagram. A piece of string connects the top of the pin with the spring.

At the end of the brass arm, *I*, is a small brass clip, *M*, hung on an axis coming out at right angles to *I*. When the current is sent through the magnet the lever arm comes forward and the clip, *M*, striking a cog turns the wheel, while the small piece of tin, *O*, is so soldered to the arm as to go down between two cogs and prevent the clip from moving the wheel forward more than one cog at a time. Above the

clip is soldered at right angles to the arm, *I*, a small piece of tin around which is wound a small rubber band, *P*, which by its pressure on the clip keeps this firmly pressed down against the cogs, but at the same time does not press so tightly as to prevent the clip being pulled back over the cog behind by the spring when the circuit is broken. A check-spring, *S*, made of a piece of brass spring-wire with a small tin arm at the end presses against the lower side of the wheel and prevents this from moving backward when the spring draws the clip back over the cogs; this check-spring is held in position by a binding post, which allows it to be lengthened or shortened as may be convenient.

The instrument as now described is ready to be attached to the chronoscope. This may be done in several ways. The following has been tried with success. A second wire (the first is described by Sanford) is run down the side of the slower pendulum about as far as *S* in Sanford's diagram, where it dips in a second, independent, mercury trough. This second wire, at its upper end runs along the top of the axis of the pendulum and has its tip bent over so as to dip into a shallow trough of mercury hollowed out of the wood on which rest the brass plates supporting the knife edges. The object of having the wire end in this way is that it may not interfere at all with the swinging of the pendulum; the wire is practically part of the pendulum, the bent end that dips into the mercury offering no resistence to the free swinging of the pendulum. The counting apparatus and a battery are now brought into circuit with the slower pendulum by means of the upper and lower mercury troughs just described. Thus arranged every swing of the pendulum sends a current through the electro-magnet, pulling the armature forward and forcing the clip, *M*, down, pushing the cog forward and turning the second-hand one division of the dial. The current being broken when the platinum point swings out of the mercury in the lower trough the spring, *K*, pulls the armature back, while the check-spring, *S*, prevents the wheel from going backwards with the clip, *M*.

The proper position of the clip, *M*, and of the stop, *O*, must be determined by trial; the clip can first be fastened to the arm, *I*, and then the place for *O* can readily be found, it being so placed that it does not bind against the cog behind when the armature is pulled back. The proper position for the check spring, *S*, and the tension of the spring, *K*, must also be found by trial, and the amount of movement of the armature necessary for the proper turning of the wheel must be regulated by the screw, *J*. A break-circuit key placed in the circuit enables the operator to stop the counting apparatus

the moment the click of the sounder shows that the two pendulums are in coincidence, and the number of the vibrations is then read off the dial.

The lower mercury trough in which the contact is made must be so arranged that the pendulum will swing lengthwise of the trough and not crosswise, in order to give as long a time as possible for the current to overcome the resistance of the magnet, and a strong current is necessary in order to pull the armature quickly away from the spring. The lighter the lever arm, and the more easily the clip works, the less current will be required. One objection to the instrument is that it makes considerable noise when the magnet pulls the armature forward against the poles, but this is obviated to a large extent by placing pieces of sheet rubber over the poles. This feature of the counting-attachment would in no way interfere with the use of the instrument for lecture room demonstrations, but would rather increase its serviceability for this purpose.

PSYCHOLOGICAL LITERATURE.

I.—NERVOUS SYSTEM.

Das Stirnhirn. Ein Beitrag zur Anatomie der Oberfläche des Grosshirns. Mit 9 Original-Abbildungen und 1 Tafel. Dr. OSCAR EBERSTALLER. Wien und Leipzig, 1890.

To the description of the frontal lobe the author devotes a book of about one hundred and thirty pages and cites a hundred and seventeen authorities in the course of his argument. The style is exceptionally lucid and vigorous and the descriptions concise. From this it appears that a careful and conscientious author can find a good deal that is worth saying concerning the external appearance of even one lobe of the brain. The observations were made on fresh brains from which the *pia* had been removed, and over 400 hemispheres were utilized. In describing the sulci and gyri of this region the author has paid particular attention to the variations which occur, and has attempted to show the relations between the extreme variations which are observed in normal individuals. The value of this method becomes at once apparent when we recall that the brains of all sorts of defectives, of individuals possessing remarkable or peculiar mental attainments, and of criminals are, in increasing numbers, the subjects of description, in which it is continuously sought to associate the sculpturing of the surface with the peculiarities known to have existed during life. Under these circumstances and with the possibilities of the normal variations but imperfectly recognized, it is but little remarkable that a good many appearances of the brain surface which have been designated, "peculiar," "anomalous," "atavistic," "criminal," "theriomorphic," etc., are really found to be variations that appear in the normal brain and to which, therefore, no peculiar significance can properly be attached. The material of the book is arranged under the general heads of Limiting Fissures, Principal Sulci, Secondary Sulci, Gyri, and Comparative Anatomy.

In discussing the various sulci—besides regarding the depth and constancy, the time of appearance in the fœtus and their comparative anatomy—the relations of the lips of the sulci are examined to see whether either of them overlaps the other, and most especially, sunken gyri and indications of branches from the main sulcus are sought. It is perhaps due mainly to care in the study of the last two points that Eberstaller is able to harmonize many of the variations which at first seem irreconcilable. For it appears that gyri which in some individuals are sunken become exposed in others, and where a gyrus usually prominent is not at first found it can in most cases be discovered in the sunken form by closer examination. This holds not only within the species, but in the mammalian series also, where the value of these sunken gyri for comparative topographical relations is equally great. The branches of the sulci have a similar value. They may be present as rudiments or extensive developments, and the amount of their extension can serve to greatly complicate the appearance of a region without introducing any essentially new features. The main object, then, in the study of the hemispheral surface, is to establish the constant locations for the sulci and then make these a point of departure when attempting to reduce any particular hemisphere to the type. In our opinion,

Eberstaller accomplishes this task in a more satisfactory manner than any author who has preceded him. Among the structures which he discusses are the cephalic branches of the Sylvian fissure; the relations of the *sulcus præcentralis inferior* to the *sulcus frontalis inferior;* the *sulcus præcentralis medialis;* the *sulcus frontalis medius* and the 4-gyral type in the frontal lobe; the *sulcus diagonalis;* the homologies of the frontal lobe region in the monkey, and of the *sulcus cruciatus* in the carnivora. Descriptions of the sulci are followed often by epitomes of the views of other writers, thus making the book valuable for historical reference.

On the Local Paralysis of Peripheral Ganglia and on the Connection of Different Classes of Nerve Fibres with them. J. N. LANGLEY, F. R. S., and W. LEE DICKINSON, M. R. C. P. Proc. Roy. Soc., Vol. 46. Nov. 21, 1889.

Led by some experiments on the salivary gland the authors compared the results of stimulating the sympathetic nerve above and below the superior cervical ganglion in an animal which had previously received a dose of nicotin. Stimulation above the ganglion, in rabbits, caused a constriction of the blood vessels of the ear and a dilation of the pupil, while stimulation below the ganglion failed to produce these effects. It was, therefore, inferred that the impulse was interrupted in the ganglion through the action of the drug on the nerve-cells. As nerve fibres are much less susceptible to the drug than cells, the method makes it possible to distinguish between the fibres which end in a ganglion and those which pass through it without interruption. An interesting application of this method to the ganglia of the solar plexus is one of the uses thus far made of this discovery, though others are suggested, and the method promises to be of wide applicability.

La circonvolution de Broca. Étude de morphologie cérébrale. Par GEORGE HERVÉ. Avec 10 figures et 4 planches caloriées. pp. 162. Paris, 1888.

The author treats his subject, the *gyrus frontalis tertius s. inferior*, by describing it in man, according to the various schemata of the gyri; in the primates; in the human fœtus; in uneducated persons; and in those distinctly intellectual. The conclusions reached are: that the gyrus in question is extended onto the orbital surface of the brain; that the primitive type of the frontal lobes, as shown in the primates, is that of two and not three frontal gyri; that the *gyrus frontalis inferior* appears first in the anthropoid apes, and is formed by a doubling of the primitive inferior frontal gyrus; that the *gyrus frontalis inferior* forms the fourth frontal gyrus in man and the anthropoids, the *gyrus frontalis medius* of the authors being in reality two gyri; that the development of this gyrus in the human fœtus recapitulates its development in the animal series—that of the right side developing earliest; that in microcephalous persons the gyrus may be either absent, rudimentary or nearly typical; that almost always in feeble minded persons and deaf-mutes and often in representatives of lower races the gyrus is but poorly developed; that in intellectual persons the complexity of the *gyrus frontalis inferior* is in a general way correlated with the development of its function. None of these conclusions are new, and the author does not make it clear that Rüdinger in 1882 covered nearly the same ground in a concise manner. Broca's schema of the gyri (p. 22) is valuable and this reproduction of it helps to make it accessible. The author has taken some part in describing the brains of several intellectual persons, and at the end of the book the descriptions are utilized together with an account of the *gyrus frontalis inferior* in the brain of Gambetta—the original description of the entire brain having been given by Chudzinski and Mathias Duval

in 1886. The plate which illustrates the gyrus in the two hemispheres is, so far as we can judge, open to the criticism that too little of this gyrus is allowed to the "convolution of Broca" on the right hemisphere, and that the sulcus designated as the *ramus anterior ascendens fissuræ Sylvii* is in both hemispheres the *sulcus diagonalis operculi* of Eberstaller and corresponding with a sulcus distinctly figured in Broca's schema as lying between the *sulcus præcentralis inferior* and the *ramus anterior ascendens fissuræ Sylvii*.

Commentary upon Fissural Diagrams. Prof. B. G. WILDER. Read before the American Neurological Association, June 6, 1890.

The two diagrams given—a lateral and mesal view of a left hemisphere—are substantially copies of those given by the same author in a previous article. They are based on 100 hemicerebrums: 65 adults and 35 fœtal or young. The majority of the lines indicating fissures are unbranched and without angular contortions. The width of these lines is taken to indicate the depth and constancy of the fissures. The diagrams differ from those of Ecker in several points, one being the introduction of some fissural names not given by Ecker. (Diagrams of the fissures may be used for several purposes, and if the purpose be that of a guide to the sculpturing of the hemispheral surface, it is a question whether much suggestiveness is not lost by extreme schematization, as in the present case. REV.)

Sehsphäre und Augenbewegungen. HERMANN MUNK. Sitzber. d. König. Preuss. Akad. d. Wissen. zu Berlin. III. Jan. 16, 1890.

This paper discusses the bearing of the observation that movements of the eyes follow electrical stimulation of the cortex in the visual area, and in this connection the author introduces the results of some experiments which he has made in collaboration with Dr. Obregia. Schäfer and others, as well as Munk, have found these movements on stimulation of the occipital cortex, and Schäfer has pointed out that their direction and character depend on the place at which the stimulus is applied. (See review in this JOURNAL, Vol. II, p. 146.) In these results Munk finds a corroboration of his views concerning the ideal projection of the retina on the occipital cortex. He objects, however, to Schäfer's idea that these movements are in response to visual perceptions and is at some pains to show that they are cortical reflexes in response to simple light sensations. It becomes further clear that the path of the motor impulses from the cortex to the primary centres lies in the bundle of radiating fibres which also conveys the fibres for the sensory impulses, and is not mediated through some other distinctively motor centre in the cortex. This is a result of considerable significance, towards which some of Schäfer's recent work also pointed. It leaves at the same time the relations of the special motor centres, from which by stimulation movements of the eyes can be obtained, quite unexplained. The prime importance of this work lies, however, in the emphasis which it gives to the two-fold function, motor and sensory, of this portion of the cortex and the suggested possibility of determining to which group of cortical elements the respective functions belong.

Ueber Augenbewegungen auf Sehsphärenreizung. Dr. ALEXANDER OBREGIA. Archiv f. Anatomie und Physiologie. Physiol. Abthl., 3 u. 4 Heft. June, 1890.

This is the full account of the research on which Munk draws for his new facts in the paper just noticed. The author gives in detail the peculiarities of the method of operating, and lays special stress on the fact that the dogs were not anæsthetized when the cortex was being stimulated, although they were anæsthetized for operation. The reac-

tions for the various portions of the occipital cortex are given in full. The indirect nature of the reaction following the stimulus is indicated by the influence of the position of the *tapetum* within the eye. This is as a rule eccentric and lies, in the dog, in the dorso-lateral quadrant of the retina. As a consequence of its position the movements of the eye in order to fixate objects below would be less than that required to fixate those above. Indeed the author seems to have been able to predict any unusual position of the *tapetum* from the degree of the various movements observed during the experiment. It would seem a fair inference from this that the elements stimulated by the electrical current were the same as those stimulated by the impulses from the retina. Since, at the same time, stimulation of the white matter, the occipital cortex having been cut away, produces similar movements, it would appear that the co-ordinating apparatus was sub-cortical.

Zur Frage der Localization der Grosshirnfunctionen. W. WUNDT. Philos. Studien. B. VI. H. I. 1890.

When reviewing a paper by Munk on the cortical localization of vision (this JOURNAL, Vol. II, p. 627) some statement was made of the criticism there contained of Wundt's position on this subject. The above heading is that of a paper in which Wundt makes reply to Munk's strictures. It is concerned mainly with the demonstration that Munk's conception of cortical localization is unclear because he confuses the localization of elementary functions, (*e. g.* color perception, which is in accord with the new nerve-physiology) with the localization of complex intel lectual activities, (*e. g.* memory pictures, which is of a piece with the old phrenology.) Wundt further goes on to show that with the doctrine of the specific energies of nerves Munk's results have little or nothing to do, and thus aims to re-establish himself in his old position. The article is referred to here mainly for what general criticism it contains of the doctrine of strict cortical localization and because it gives Wundt's present views on the subject in a somewhat connected form.

Ueber Rindenblindheit. D. FÖRSTER in Breslau. Von Græfe's Archiv f. Ophthalmologie, B. XXXVI, Abt. 1, Leipzig, 1890.

The author describes the case of a man who being 44 years of age, in 1884, suddenly, without other disturbance, developed a double hemianopsia involving completely the right halves of both visual fields. The vertical line bounding the defective region, instead of passing directly through the fixation point went 1° to 2° to the right of it. The acuteness of vision was at first decreased, but in five months returned to the normal. The patient was able to attend to his business which was that of a post-office official. Somewhat less than five years later the vision of the patient became further impaired while he was on a walking trip during his vacation. This new attack took some three days to fully develop. After it he was apparently completely blind. Six weeks subsequent to the last attack Förster saw him and found that he had a very small region in the central part of each retina which still functionated, a visual field which could be imitated by looking through a tube 81 mm. long the further end of which was closed by a diaphragm having in it an opening 1 mm. in diameter. With this he could read fine type, distinguish objects by their shape, if they were small, but could not distinguish colors. Further than this his conception of the relation of objects in space to one another and to himself was very seriously impaired and he was incapable of profiting by experience in supplying himself with new data on such points. Förster diagnosed the case as a thrombosis of the principal arteries supplying the visual area of the occipital cortex. A study of the mental defects in this case showed that while the patient had no difficulty in describing in visual terms

experiences of his previous life, yet he could not draw nor describe a map of any sort, not even the arrangement of the furniture in the rooms he had been accustomed to occupy, and that with his eyes either bandaged or uncovered his ability to find his way about was far below that of the average individual blind though a peripheral lesion. Förster draws the following conclusions: Since the retina is, for a small extent at least, intact, the color blindness cannot be of peripheral origin. In the occipital cortex are located the perceptions for topographical relations. Further, he takes the case to disprove the view that the crossed and uncrossed optic fibres are mixed in the fovea, (this explaining hemianopsia with the retention of vision in the fovea,) and, if I understand him correctly, assumes a complete crossing of the optic fibres and explains the retention of vision at the fovea by considering that the anastamotic connections of the vessels supplying the cortical centre are more complete for the part of the cortex representing the fovea, and hence that a plugging of the arteries as in this case affects vision at the fovea least and last of all. The ophthalmoscope had thus far revealed no atrophy in the optic nerve.

Case of cerebellar tumor with monocular diplopia as a symptom. A. B. SHAW. Alienist and Neurologist. July 1890. Vol. XI. No. 3.

The diagnosis is given in detail, and it is simply stated that the results of the autopsy were entirely concordant with it. The lesion was on the left side, and there was homonymous hemianopsia, and diplopia of the left eye.

Zur Lehre von der Kreuzung der Nervenfasern im Chiasma Nervorum opticorum. Dr. ANTON DELBRÜCK. Archiv f. Psychiatrie und Nervenkrankheiten. B. XXI. H. 3. 1890. 1 Taf.

The author first describes the optic nerves and tracts from an insane man of 70 years. As the patient never exhibited any noticeable disturbance of vision no examination of the eyes had been made, but at the autopsy the left optic nerve was found nearly completely degenerated, while the right was about half degenerated. The study of the specimen shows a connection between the optic nerves and optic tracts of the same sides, which is explained by considering that in this case it is mainly the uncrossed bundle of fibres which has been preserved. The general discussion of the course of the optic fibres contains a fundamental critique of the conclusions of Michel, whose advocacy of total decussation of the optic fibres some years since re-opened the whole question. In this connection Delbrück shows that the ideas that the chiasma offered a resistance to the degenerative process and that degeneration was progressive, were freely used by authors reasoning on this question.

He considers that the study of the fibres in this region should be guided by the following practical rules: 1. If there are normal fibres in the optic nerves there must be corresponding normal fibres in the optic tracts. The converse also is true if the commissural fibres in the tracts are excluded. 2. If there are degenerated fibers in the nerves there must of necessity be degenerated fibres in the tracts, but these may be either plainly recognizable by their degenerated remains or may have undergone resorption to such an extent as to be no longer evident.

To these two, just given, the author adds several other suggestions:

a. In comparing a degenerated nerve which contains two groups of fibres with its mate which is normal, and drawing from this a conclusion as to the size of the degenerated portion it must always be remembered that the extent to which the degenerated portion has been resorbed will very materially influence the result. *b.* When one optic nerve is degenerated and both tracts are found almost or apparently completely normal the inference is valid, under certain conditions, that the degenerated fibres

did not form a compact bundle. At the same time the residua of even a compact bundle may disappear in the cases where resorption is very active, as in young animals, for example. c. If a compact bundle can be traced in a tract for some distance and then disappears, the possibility that the fibres may run for a time isolated and then intermingle with the others forming the nerve, must always be admitted.

Reviewing the literature in the light of the general conclusions thus given, the author proceeds to examine the evidence for the position of the crossed and uncrossed optic fibres both in the tract and in the nerve. The evidence is not decisive. In the optic nerve the uncrossed fibres form a more or less closed bundle; but whether its usual position is laterad, as indicated by the majority of the cases, or whether it is more often variable, is uncertain. In the tract the majority of authors report a more or less isolated condition of the uncrossed bundle and a lateral position. It is to be borne in mind, however, that just these cases were most liable to be reported, since in them the results of the lesion were most clear and definite. This entire paper is an unusually valuable contribution to this subject, and it may be noted in passing, that it was offered as a dissertation for the degree of M. D. at Leipzig.

Ueber die Folgen der Durchschneidung des Hirnbalkens. ALEXANDER v. KORÁNYI. Arch. f. d. ges. Physiologie des Menschen u. der Thiere. B. XLVII. H. 2 u. 3. Feb., 1890.

The work was done in the laboratory of Prof. Goltz at Strassburg. The author concludes that section of the callosum (in dogs) causes no marked disturbance, unless the hemispheres are at the same time injured. In case of such injury there may appear disturbances of vision, of tactual sensations and of motion. and that, too, when the injury of the white matter is to a portion far removed from that to which the respective functions are attributed. The disturbances, however, are transitory. Further, after section of the callosum, convulsions of the entire body may appear. There is wanting in this account the descriptions of the lesions, and the statement as to the number of experiments and the length of time that the animals survived the operation in each case, all of which data are necessary for the proper valuation of the results.

Further note on degenerations following lesions of the cerebral cortex. C. S. SHERRINGTON. The Journ. of Physiology. Vol. XI, Nos. 4 and 5.

When the pyramidal tract degenerates as a result of injury to the cerebral cortex, degenerated fibres are found in the following portions of gray matter, 1. Ventral gray *cornua* of spinal cord. 2. Lateral gray *cornua* of spinal cord. 3. Isolated gray masses in the *pons*, lying among the deep transverse fibres of the *pons*, (*stratum complexum pontis*) and close to the fibre bundles of the *crusta*. 4. A mass of gray matter lying in the mesal third of the crustal portion of the *crus cerebri*, (a well-defined mass in the monkey). 5. The *substantia nigra*, more especially the ventral portion of it. Interest attaches to these fibres, which are always of small size, because they are considered to be in connection on the one hand with the gray matter and on the other with the pyramidal fibres. In the spinal cord a degeneration of the fibres in the column of Clark has not been found associated with pyramidal degeneration. In cases of cortical lesion confined to the "leg area" a considerable number of fibres in the *substantia nigra* are found degenerated. To what animals these results apply is not stated.

Einiges über das Gehirn der Edentata. H. RABL-RÜCKHARD. Archiv f. Mikros. Anat. B. XXXV, H. 2. Mai. 1890. 1 pl.

From the examinations of cross-sections of the brain from a fully developed fœtal armadillo, (*Xenurus gyrunurus*), the author identifies a

bundle of fibres each side of the middle line, and connected with the *commissura anterior*, with the *pars frontalis commissuræ anterioris* as described by Osborn for the kangaroo, by Flower and Sander for some other marsupials, by Ganser for the mole, and by Hamilton for the human brain. A second portion of the paper deals with the conformation of that portion of the Sylvian aqueduct which may be considered the homologue of the *torus longitudinalis* in the bony fishes.

Ueber den feineren Bau des Vorderhirns der Amphibien. A. OYARZUN. Archiv f. Mikros. Anatomie. B. XXXV, H. 3. Juni, 1890.

The author worked under the direction of Edinger and studied the forebrain in some amphibia (frog, triton and salamander). It has been the current view that undoubted ganglion cells could not be demonstrated in the mantel of the forebrain in vertebrates lower than the reptiles, and hence the homologue of the cerebral cortex of the mammals was considered to be first recognizable in this group. By using a modification of Golgi's method, Oyarzun has been able to demonstrate connective tissue cells and ganglion cells also in the mantel of these amphibia and show that the direction of the axis-cylinder processes from the ganglion cells is that which might be expected. The entire arrangement of the mantel is highly embryonic even in the adult frog, and this gives additional ground for considering the mantel in this case as but slightly differentiated.

II.—EXPERIMENTAL.

Les lois de la fatigue étudiées dans les muscles de l'homme. par ARNALDO MAGGIORA. Travaux de Lab. de Physiol. de Turin, 1889, p. 213. Also, Arch. f. Anat. u. Phys. (Phys. Abth.), H. 3-4, 1890, p. 191.

This is an experimental study, on the muscles of man, of the influences which favor and hinder muscular work. The experiments were made on the flexor muscles of the middle finger. The movements of the finger were recorded by the method described by Prof. A. Mosso in a paper having the same title as this and published in *Travaux de Lab. de Physiol. de Turin*, 1889,—p. 150, also *Archiv. Ital. de Biol.* XIII. p. 123, in a paper read before the Internat. Cong. of Physiol. at Basel, Sept. 1889, and in the *Archiv f. Anat. u. Physiol.* 1890, p. 89.

In the experiments of the author the muscles were stimulated voluntarily or by an induction current applied directly to them or their nerves. The contractions were always maximal, occurred at regular intervals and raised a weight of known amount, the weight being supported during the intervals. The contractions were continued until the power to raise the weight was lost. The record gave the height to which the weight was lifted by each contraction and thus the total amount of work done was readily computed. The amount of work possible was found to vary with the weight and the intervals of rest between the succeeding contractions.

With small weights the work can be continued a very long time even when the contractions succeed each other rapidly. With larger weights, one or more kilos, there is a certain weight for each individual with which, at a given rhythm, he can do the most work before the fatigue becomes complete. The curve of fatigue may be a straight line with a certain weight and a certain rhythm. If the rest between the succeeding contractions be ten seconds no fatigue is seen. The interval is sufficient for the restoration processes to be complete. This recalls the life long work of the heart. An interval of rest sufficient to prevent fatigue by a medium weight is insufficient with a larger weight. It is

not sufficient on doubling the weight to double the interval of rest. As the weight is increased the rest must be lengthened much more rapidly. This proportion would probably differ with each individual. In making a series of experiments in which the muscles were worked to fatigue, it was found that rests of 1¼ to 2 hours must intervene between the successive experiments to enable the muscle to completely recover. The time required was found to vary greatly with the individual. The general condition and habit of life probably being very important factors. In experiments in which the maximal contraction was sought each time, it was found that the effort fatigued more than the work accomplished. Therefore to obtain the most work it was necessary to rest frequently. For example with two kilos, it was best to contract every two seconds for one minute and then rest one minute. To obtain the most work from a muscle during a day, the muscle should not be worked to complete fatigue, as work injures a fatigued muscle more than a greater amount of work hurts a fresh muscle. Though a muscle can recover from fatigue in two hours, it can do more work during a day if it makes only 15 contractions every half hour. Anæmia causes the muscle to fatigue rapidly even when a rate of contraction be chosen which does not normally cause fatigue. This was seen in experiments in which the anæmia was artificially produced by compression of the artery. Maggiora corroborates Mayer's statement that fatigue produced by long continued muscular work affects other muscles besides those which were engaged in the work and lessens their power. The fact that the first contractions of muscles thus weakened are good shows that their irritability is not lessened. Nevertheless these muscles rapidly weary, and this is true for electrical as well as voluntary stimuli, which shows that it is the peripheral as well as perhaps the central mechanisms engaged in the voluntary act, which are affected by the general fatigue. The effect is much the same as that seen in anæmia of the muscle. Further it was found that when the muscle was thus weakened by general fatigue it responded better to the will than to direct electrical stimuli. General muscular fatigue was caused in the case of the author, who was leading a sedentary life, by a walk of ten kilometres, while a march of 32 kilometres had little effect on two soldiers, and 64 kilometres were necessary to give a marked result in their case. After this long march the influence of the fatigue lasted one day, and on the next day they had recovered their muscular power. Loss of sleep was found to cause general fatigue of the muscles. A fast of twenty-four hours had the same effect. The power lost by fasting began to return almost immediately after food was taken and the muscle was capable of almost a normal amount of work half an hour after the meal. Experiments with electricity showed that the peripheral mechanisms were thus affected by the loss of sleep or lack of food and that the fatigue was general. Experiments with massage showed that a muscle recovers its power very rapidly if massaged during the interval of rest; fifteen minutes instead of two hours being sufficient to restore the muscle. Four times as much work can be done when the muscle is massaged during the period of rest as when it is simply allowed to remain quiet. When the intervals of rest are too short the muscle recovers less and less completely in spite of the massage. How far fatigue of the muscle is dependent on lack of nutriment and how far on the accumulation of the waste products resulting from the chemical changes occurring during work is uncertain. At the close the author states that the power of his muscles doubled in six months. This change was not due to exercise, but to an improvement in his general condition. W. P. L.

Les lois de la fatigue étudiées dans les muscles de l'homme.[1] By Prof. ANGELO MOSSO. Travaux de Lab. de Physiol. de Turin, 1889, pp. 149–212. Reale Accad. dei Lincei, Serie 4, Vol. V, 1888. Archiv f. Anat. u. Physiol. 1890, p. 89. Paper read before The Internat. Cong. of Physiol. at Basel, Sept. 1889. Archiv. Ital. de Biol. t. XIII, p. 123.

The apparatus and experiments described in this paper are of great interest. Not only do they open a large field for work, but they unite more closely than has yet been done the nerve-muscle physiology of the lower animals with that of man. In addition to this they show an intimate connection between the fatigue of the central nervous system and that of the muscles. Two new pieces of apparatus are described and many suggestive experiments recorded. The paper is illustrated by 64 plates. The work covers a wide field, viz: 1. Description of the "Ergographe" and "Ponomètre." 2. A comparison of the curves of fatigue of voluntary muscular contractions with those produced by excitation of nerves and muscles. 3. The fatigue of nerve centres. 4. The influence of psychic fatigue on muscular force. 5. Inhibition of voluntary movements by electric excitation of motor nerves. 6. Muscle contractur. 7. Effect of fatigue on muscle elasticity. 8. Influence of a support on the height of muscular contractions.

In the hope of studying on man the laws of fatigue of the muscles, Mosso constructed an apparatus, which he named the "Ergographe." With it he was able to record the mechanical work performed by the flexor muscles of the middle finger, when contracted voluntarily or in response to an induction current applied directly to the muscles or to their nerves.

If a weight were raised with each flexion of the finger, the work done and the corresponding fatigue were recorded. By means of this apparatus he was able to test on men the results which have been obtained heretofore chiefly on frogs, and the lower warm blooded animals.

Each individual gives a characteristic curve of fatigue and this varies with changes in his general condition as well as local alterations.

It was found that human muscles have an excitability and energy peculiar to themselves and that they weary independently of the excitability and energy of the nerve centers. Thus the muscles are seen to be the seat of certain phenomena of fatigue which thus far have been thought to arise in the central nervous system and to belong essentially to it.

The other new apparatus used in these experiments is the "Ponomètre." By it, the weight is released at a certain point. The further unintentional contraction, made without the weight, depends on the amount of nervous energy employed to compel the muscle to raise the weight. The height of these contractions was seen to increase as the muscle tired and Mosso concluded that this was due to the fact that more nervous energy was developed to produce the desired contraction of the fatigued muscle.

Fatigue of nerve centres. With the "Ergographe" one can study the fatigue of the nervous centres, because one can measure the work of which the muscle is capable, when it is stimulated directly or through its nerve, and compare this with the work which can be done voluntarily. It was found by such experiments that more work could be done by electrical stimulation of the nerve than by voluntary contraction of the muscles. This is true in spite of the fact that one can voluntarily

[1] This paper is supplemented by a paper by ARNALDO MAGGIORA. *Les lois de la fatigue étudiées dans les muscles de l'homme.* Reale Accad. dei Lincei, Vol. V, Séance Nov. 4, 1888. Travaux de Lab. de Physiol. de Turin, 1889, p. 213. Many of the experiments described in this paper were made with Maggiora, and Mosso often refers to his work.

lift much heavier weights, and results from the rapid fatigue of the central as compared with the peripheral mechanism. The muscle is still capable of contracting in response to an electric stimulus applied to its nerve long after the voluntary power has ceased.

Influence of psychic fatigue on muscular force. Having found that the central nervous mechanisms fatigue during muscular work, Mosso sought the effect of central fatigue on the force of voluntary muscular contractions. He found that when a man was mentally tired by a severe examination his voluntary power was lessened. Before concluding that this loss of power was due entirely to central fatigue, he tested the muscle with electricity and found that the absolute power of the muscle itself was lessened. That is to say, he found that the muscles are weakened by severe mental work. The source of this weakness was then studied. It seemed more likely that it was due to some change in the blood than to an influence exerted by the brain through the nerves. Two ways suggest themselves by which the effects of fatigue might work through the circulation, viz., 1. A material poisonous for the muscles might be developed in the brain, as a result of the chemical changes accompanying its work, and thence pass into the general circulation. Or 2. The muscles, as less important mechanisms, might cede a part of their nutriment to the nervous substance as is the case in fasting. Experiments showed that the weakness which results from fasting is rapidly recovered from on taking food, while that caused by vigils and by forced marches is recovered from only by repose of the nervous system, i. e. sleep. These facts make it probable that during severe nervous work a material is produced which on entering the circulation acts as a poison and weakens the muscles. To prove this supposition Mosso tried the effect of injecting blood from a tired dog into one that was fresh. He found that it acted as a poison and produced all the signs of fatigue, though injecting the blood of a fresh dog had no such effect. The result of this experiment was a strong argument in favor of the idea that the weakness which results from mental work is due to a poisonous material produced by chemical changes in the brain.

Inhibition of voluntary movements by electricity applied to motor nerves. Mosso corroborated the observations of Schiff and Fick that an interrupted current applied to a motor nerve prevents the voluntary contraction of the corresponding muscles. He found a weak current to have no inhibiting effect, though it produced a slight contractur of the muscles. A strong current causes a tetanus. A medium current inhibits the voluntary contraction and produces a contractur. The current must last at least 1-5 second to have an inhibitory effect. The voluntary power returns immediately on the removal of the current. This inhibition does not seem to be a reflex phenomenon.

Muscle contractur. Mosso studied on men with the "Ergographe" the phenomenon of contractur, with reference to the results of Tiegel, von Frey, Rossbach, Richet, von Kries and Kronecher, gained from experiments on frogs, etc. He irritated the muscles of a man with a tetanizing current of medium strength every two seconds, and saw a series of contractions the record of the first five of which, on account of the contractur, formed steps, each contraction reaching a higher level than the preceding. At the summit there was a contraction lower than the rest, and then the contractur began to diminish and continued to lessen until the record again started from the abscissa. At its height the contractur was so strong that it supported the weight of 500 grms., at a higher level than the first contraction had lifted it. When the contractur began to lessen, the fatigue seemed to begin. The contractions, which were then greater than at the beginning, fell off rapidly. In voluntary contractions the amount of the contractur varies with the person and the way the weight is applied. It may be strong enough to lift 3 kilos.

Though diminishing as the fatigue comes on, it may in certain persons persist to a certain amount even after the fatigued muscle ceases to respond to stimuli. A very short rest is sufficient to restore the contractur. The intensity of the contractur is in relation to the intensity of the electric excitation up to a certain maximum. It is less marked with voluntary contractions than with those produced by electric excitation. It is only well marked with light weights. The adding of a heavy weight for a time, may be followed on return to a light weight by the contractur. Contractur is entirely a muscular phenomenon in spite of the fact that it is seen more marked in persons in an irritable condition. Indeed in experiments on animals it may be observed on curarized muscles. This observation is important as showing that many phenomena accompanying exaggerated excitability are of peripheral origin and independent of the central nervous system. The contractur seems never to occur in certain muscles as of the eyes, and in other muscles only to accompany excessive effort. It seems to be almost an abnormal condition, a symptom characteristic of an alteration of the muscle produced by too great excitation, and hence as a form of fatigue manifested in the muscle as it passes from a state of rest to that of work. It is probable that the first contractions of a fresh muscle differ from those of a fatigued muscle. Maggiora shows that a fatigued muscle is injured more by work than a fresh muscle. The shape of the muscle curve is influenced, not only by the contractur, but by the elasticity of the muscle and many other factors, so that its interpretation is most difficult. Mosso promises another paper on this subject. In spite of apparent contradictions he looks upon the contractur as a phenomenon of fatigue. It is certain that the nervous excitation produces in the muscle other effects than contraction. One recalls Bowditch's "Treppe." Mosso regards the "Treppe" as due to fatigue. It can be prevented by massage, and he thinks it ceases because the muscle by its contractions massages itself. The relation of these questions to the theory of tetanus is most important and it is to be hoped that Prof. Mosso will continue his work in this direction.

Effect of fatigue on elasticity of muscles. In some experiments the elasticity seems diminished by fatigue, in others the results are masked by the continuance of the contractur. The confusion of terminology—contractur, tonicity, elasticity, makes a clear understanding and statement of results a matter of great difficulty.

The influence of a support on the height of the contraction. The curve of fatigue is uninfluenced by having the weight supported at various heights during the work when the muscle is fresh, but if it be weary the partial removal of the weight increases the height of the contraction, i. e., when fresh, the muscle gives a maximal contraction regardless of the weight, but when weary it is aided if the weight be supported at a certain height. W. P. L.

Ueber die kleinsten wahrnehmbaren Gesichtswinkel in den verschiedenen Teilen des Spektrums. W. UHTHOFF. Zeitsch. f. Psychol. Bd. I, H. 3. 1890.

In connection with his studies on the acuteness of vision, Uhthoff has re-determined the smallest angular distance by which two objects must be separated in order to be seen separately, when illuminated with light of different colors. The importance of his determination rests on his having used spectral lights. The visual object was a fine wire net specially made for the purpose in which the intervals between the wires were just equal to the diameter of the wires, i. e., 0.0463 mm. This was seen against the face of a large prism so fixed that its whole surface was presented to the observer illuminated with one monochromatic light. The wire-net was moved backward and forward between the

eye and the prism till its wires reached the limit of separate visibility. The intensity of the light was made so great that no increase of intensity caused an increase in the visibility of the wires. Wave lengths 670, 605, 575, 535, 505, 470, 430 $\mu\mu$, corresponding to the seven spectral colors were used. The experiments show that the *color* of the light has scarcely any influence provided that the *intensity* is sufficient. The limit was reached for one observer when a wire subtended an angle of about 32.″8, for the other 27.″6, corresponding respectively to retinal images of 0.00234 mm., and 0.002 mm. The value generally assigned for this angle is 1′ and these experiments, when the measurement is made in the same way, i. e. from the middle of one wire to the middle of the next, give substantially the same result, namely: for one observer 65.″6, for the other 55.″2.

Ueber die Muskuläre Reaction und die Aufmerksamkeit. GÖTZ MARTIUS. Philos. Stud. Bd. VI, H. 2.

The question here discussed is the significance of the important distinction between "sensory" and "motor" forms of reaction as introduced by Lange. The distinction itself Martius fully corroborates, finding it somewhat small in practiced reactors (about 20σ), but marked in two novices (about 100σ.) He, however, agrees with Wundt that the distinction is confined to simple reactions, and questions the validity of Münsterberg's extension of this distinction to more complicated reactions. He has repeated Münsterberg's experiments of reacting with the five and with the ten fingers to the first five and first ten numbers, the reaction to five vocal sounds, to five different declensional forms, to five categories such as a "river," "a city," etc., and finds in all these cases where Münsterberg found a large and increasing difference between the "sensory" and "motor" reactions, only a slight difference; and while Münsterberg finds the "sensory" longer than the "motor," Martius has a flatly contradictory result. While unable to explain Münsterberg's results, he feels confident that no true distinction between motor and sensory was there involved, and that it is impossible to apply this distinction beyond the simple reaction. The second portion of the study describes simple reactions in which the subject, after each reaction, gave a judgment as to its comparative worth, and also described his attitude of mind at the moment of reacting. This very commendable method is not carried forth with sufficient system to allow of easy formulatable conclusions, but they leave in Martius's mind an increased confidence in the value of his results. A third point discussed at length is the mechanism by which the shortening process of the motor reaction takes place. In opposition to the view that it is a return to a reflex mode of action—a view which he treats too literally—he holds that the motor reaction anticipates and takes for granted the precise nature of the stimulus and therefore reacts to it at an earlier stage of its development.

The most essential and puzzling contribution of this paper is the opposition to Münsterberg's results; only careful and abundant research can explain this important point. J. J.

Untersuchungen zur Mechanik der activen Aufmerksamkeit. GEORG DWELSHAUVERS. Philos. Stud. Bd. VI, H. 2.

The author has determined anew the effect of a signal preceding the stimulus in reactions, with due reference to the distinction between "sensory" and "motor" reactions. He finds that reactions to the fall of a hammer preceded by a signal at an internal of 1½ seconds, were executed in 257σ sensory and 130σ motor; if the interval was 3 seconds, the times were 280σ and 133σ; if 6 seconds, 300σ and 149σ, (average of 5 subjects). On the other hand, when no signal preceded, the "sensory"

time was 305σ and the "motor" 188σ. In all these results the attention was closely focused upon the reaction. If the attention were purposely diverted from the reactions and no signal preceded, the time was 353σ. The chief result is thus a corroboration of the distinction between "motor" and "sensory" as well as of the effect of a preceding signal, with accurate determination of the effect of the interval between signal and stimulus upon the reaction-time; it is also shown that the advantage of the signal is greater with "sensory" than with "motor" reactions. The second portion of the research is devoted to the same problem with which Martius (see above) has occupied himself, *i. e.*, the correlation of the subject's own version of the value of his reaction and the state of his attention at the time of reaction. He finds that a complete attention takes place in 85 per cent. of all cases, and that total inattention is rare, and ventures the generalization that as the accuracy of the attention increases the time decreases. The subjective testimony would also indicate that the distinction between "sensory" and "motor" is only a relative one, transitional forms and times appearing everywhere. One's own opinion as to the quickness of the reaction, Dwelshauvers does not value as highly as Martius, but regards it as very liable to effects of contrast and other illusions of judgment. J. J.

Mental Tests and Measurements. J. McK. CATTELL. Mind, XV, 373; July, 1890.

Prof. Cattell here presents in detail the plan for psychic tests mentioned in his note upon Psychology at the University of Pennsylvania in the last number of this JOURNAL. These are: 1, Dynamometer pressure; 2, Rate of movement; 3, Sensation-areas; 4, Pressure causing pain; 5, Least noticeable difference in weight; 6, Reaction-time for sound; 7, Time for naming colours; 8, Bi-section of a 50 cm. line; 9, Judgment of 10 seconds time; 10, Number of letters remembered on once hearing. Numbers 2 and 4 have not so far been much tried, but are promising; new instruments have been devised for making them. These ten tests are now taken at Prof. Cattell's laboratory upon all that are willing, and his students are submitted to a much longer series, a list of which is also here given. Discussion and co-operation is invited (and some notes by Galton are appended to this article) to the end of securing the best methods and uniformity in using them. This move is in the right direction; some standard series of mental measurements is a thing very much to be desired, and uniformity is no less important. Prof. Cattell has upon the stocks a laboratory manual of psychology, a book much needed at this stage of the teaching of experimental psychology.

Ueber die Wahrnehmung und Lokalisation von Schwebungen und Differenztönen. KARL L. SCHAEFER. Zeitschrift für Psychologie und Physiologie der Sinnesorgane. Bd. I, H. 2. 1890.

That the ear has a certain power of judging the direction and distance of sounds, no one will deny, but how will it locate those that actually have not a single source, that arise from the combination of two other sounds? The most readily audible of such sounds, "beats" (due to interference) and difference-tones, (due to the mechanism of the ear) have been examined in this particular by Schaefer. His experiments were made with tuning forks and lead to the following results. Beats: When the beating tones are of unequal intensity the stronger of the two fixes the apparent place of the beats; when they are of equal intensity the beats are referred to the intermediate space—thus, as a special case, when one tone reaches one ear only and the other tone the other ear only, the location of the beats is in the median plane or even in the middle of the head. Difference-tones: When the generating tones are

produced in the median plane of the body or symmetrically on either side of it (and at the same time are equally intense) the difference-tone seems to be in the median plane within the head, sometimes mid-way between the ears. When both generating tones are on one side of the head the difference-tone is heard in or near the ear on that side and is not referred to the generating tones. When the generating tones are not equally intense, one being produced before one ear the other before the other, the difference-tone is heard on the side of the fainter generating tone—a result due apparently to the more favorable relation of intensities existing on that side. Dove, Stumpf and Thompson failed to hear the difference-tone with the generating tones in this position, but probably because of imperfect conditions. The 32 forms of experiment contributing these results, as well as notice of the effect of different positions of the generating tones upon the intensity of the "beats" and difference-tones, are set forth in the original. [These results are in harmony with the general principle that a sound is located upon the side on which it is most intensely heard; or if equally intense on both sides, in the median plane. REV.]

Die Association successiver Vorstellungen. H. MÜNSTERBERG. Zeitsch. f. Psychol. Bd. I, H. 2. 1890.

The theory of association here advocated by Münsterberg is that the connection of any two members of a memory series depends either on their more or less complete simultaneousness in consciousness (or the simultaneousness of their nervous correlates), or, if successive, on their connection with the members of a parallel motor series (made up of the reflex movements or tendencies to movement which attend sensory processes). Thus sensory image *a* is connected, because simultaneous, with motor impulse *A*, the latter with motor impulse *B*, and that in turn with sensory image *b*. Image *a* can thus call up image *b* indirectly though wholly lacking direct connection. In addition to a statement of the difficulty of conceiving the connection of neurological processes wholly successive, the author presents experiments going to show a connection by way of these motor accompaniments. The experiments fall into two groups. In the first written letters are exhibited in such a way that each letter was seen by itself for one second till from four to ten had been shown. The subject, Münsterberg himself, was required to fix the series in mind and at the end repeat the letters in order. He found that he was able to repeat seven letters without error, but reached the limit of his ability with a series of 10. The errors which he made, and this is the important point, were mostly the substitution of wrong letters, *almost never errors in order;* taking reproductions of series of all lengths only about 1 per cent. were affected by errors of this kind. In the second group the setting of the experiment was the same as in the first; but the subject, instead of being able to concentrate his mind on holding one letter till the next came or even to say them in his head, was deprived of such aids by being required to work problems in mental arithmetic aloud (such as adding continuously), while the letters were shown. The result was a fall of the limit of possibility from 10 to 7-letter series, and of that of perfect reproduction from 7 to 4 or 5. More important, however, is the fact that *the order of letters, even when the right ones were given, was very frequently wrong.* Of 100 4-letter series only 6 contained wrong letters, but 52 were wrong in order; of 100 5-letter series, 10 contained wrong letters and 64 a wrong order; and the 6-letter series were very much worse. The effect of simple distraction of attention shows itself in the fall of the limits of possible and perfect reproduction, but the errors in order must have another explanation. This is to be found in the fact that the mind was not at liberty to hold one letter till the next came (hence association by simultaneousness was

excluded) nor able to connect them serially by means of their natural reflex motor accompaniments, because the speech apparatus was fully occupied with the loud reckoning. There was therefore no means of serial connection left, though the letters were impressed on the memory singly. With this explanation the subejctive observation of Münsterberg during the experiments agrees.

The author holds that the serial connection in the motor series is quite another matter from that in the memory series. The point is an important one, for unless this is so he still has to account for one link in his chain, and to the reviewer's mind it should have had a much fuller and better demonstration. The experiments, however, are valuable and the paper, unlike those in the author's Beiträge, is brief and to the point.

E. C. S.

Ueber negative Empfindungswerthe. Briefe von G. TH. FECHNER, herausgegeben von W. Preyer; (Schluss). Zeitsch. f. Psychol. Bd. I, H. 2.

The five letters given in this section continue the discussion of "negative sensations" upon the lines followed in the former section (Zeitsch. f. Psychol. Bd. I, H. 1; review, *Amer. Jour. Psychol.* III, p. 288), and bring the correspondence to a close, evidently without the surrender of either party. New analogies are introduced and Fechner makes clear his strict limitation of his formula and its deductions to *psycho-physic* phenomena, refusing to have it carried over to purely psychic matters and withholding assertion as to its applicability in purely physical ones. In the course of the letters reference is several times made to the views of Hartmann on the physiology of consciousness.

III.—CRIMINOLOGICAL.

By ARTHUR MACDONALD, PH. D.

Tipi di criminali nati, GUIDO ROSSI e S. OTTOLENGHI, Archivio di Psichiatria, Scienze Penale ed Antropologia Criminale, Vol. XI, Fasc. 1, Torino, 1890.

As an example of the way in which criminals are studied by the Italian specialists, we give the details of a single case.

The writers investigated two cases of typical born-criminals. The first case (by Rossi) is as follows: S. C., 38 years of age, born in Turin, a type-founder by trade, condemned twice; the first time, ten-year sentence for cruelty to father. While in prison he attempted suicide twice. Being unable to work, he wrote his history upon a vessel. Always suffered sensations of heat in the head; was subject to vertigo; had an alcoholic attack and epileptic prison insanity, *follia carceraria epilettica*, during which he broke the glass in the window, for having been punished excessively; did not think in such moments of the possibility of being punished again; had a true morbid epileptical hypochondria. His physical examination gave: pallid skin, thin chestnut hair, abundant beard, thin moustache, blue iris; nose long and crooked; teeth: median incisors hypertrophied, the lateral decayed; slightly projecting ears, squint in left eye, paralysis of the eyebrows. Craniometry: anterior-posterior diameter, 182 mm.; transverse, 151 mm.; anterior-posterior curve, 340; transverse, 317; total circumference, 540; cephalic index, 83; cranial capacity, 1530; a depression at the union of the frontal and parietal, not evident whether it is due to a wound or not; lacks the ethnic type; a scar on right hand arising out of a dispute after gambling. Sensibility: with Faradaic current, the right hand feels at 32, the left hand at 35; touch gives 3 mm. for left and 2 mm. for the right. Meteorological sensibility is moderate; two or three days before bad weather he is restless. He is credulous; was made to see a bottle

of black wine under a white paper. At nine years of age was given to masturbation. The dynamometer gave 46 for the left hand, 53 for right. Motility: gait awkward; speech stammering; writing good; knee-jerk exaggerated; had a simian agility since infancy. He walks often without consciousness of where he goes; this is one form of propulsive epilepsy; at certain moments there comes to him a desire to destroy everything, and often he does it. He does not believe in any religion. He sleeps uneasily; commenced to like wine at ten; was forgetful; smoked; liked gambling; is fond of striking; knows the criminal slang. His father was 44 at the birth of S. C.; his mother 50; his father drank much, but supported the wine, and was never in jail. The mother played much at lottery; his sister was mother of thirteen sons, all healthy, except one who died, disease unknown. He was studious in his four elementary classes; said he never had difficulty in learning. He reads the *Cronaca dei Tribunali*. He does not like the present system of government; would like the republican form. In infancy he suffered with *ematurie* and neuralgia.

Le crime politique et le misonéisme. CESARE LOMBROSO. Nouvelle Revue, 15 Fév. et 1er Mars, 1890.

This article, by one of the founders of Criminal Anthropology, shows some of the broader social aspects of the science of crime. While a certain freshness of experience brings enjoyment, suspicion and hatred of the new (misoneism) is deep-seated and characteristic in society and the individual, most so in the feeble and primative. Innovators, reformers, geniuses are opposed, and, since even they do not escape this law, oppose each other. The same law pervades religion and pedagogy. Disregard of the misoneistic feeling in sudden and violent attempts at progress is anti-social and a crime. Revolutions are distinguished from revolts and seditions in being normal steps of advance; they do not excite conservative reaction; they have high aims and moral causes; they appeal to people of all classes; they reach success in spite of loss of leaders; they are rare and characteristic of advanced nations. Revolts and rebellions are the reverse of all these; society is not prepared for them, they are abortions. In doubtful cases society itself decides, by accepting or rejecting the attempted advance, whether the attempt is a revolution or a rebellion.

Mittheilungen der internationalen kriminalistischen Vereinigung; Heft 1, Februar, und Heft 2, Juli, Berlin, 1890.

The International Penal Law Association was founded in 1889; principally through the efforts of Prof. Franz von Liszt of the University of Halle. It will be seen from the principles advocated by the association (given below) that it takes the most advanced views in practical criminology.

The International Penal Law Association holds that crime and punishment should be considered from the sociological as well as from the juristic standpoint. Its fundamental propositions are: (1) The purpose of punishment is to oppose crime as a social phenomenon. (2) The results of anthropological and sociological investigations are therefore to be considered. (3) Punishment is one of the most effective means of opposing crime, but not the only one, and therefore should not be separated from other remedies, especially that of prevention. (4) The distinction between occasional criminals and habitual criminals is of fundamental theoretical, as well as practical, importance, and therefore serves as a basis for the determining of penal legislation. (5) Since the administration of penal justice and its execution have the same purpose, they should not be separated, for in addition the judicial sentence gains its content and meaning from the execution of the punishment. (6) As the restriction of freedom rightly takes first place in our penal

system, the Association devotes itself to efforts for the improvement of prisons and related institutions. (7) Yet the Association holds that the substitution of short restraints of liberty for other penalties of equal efficacy is possible and desirable. (8) In long restraints upon liberty, the duration of punishment is to depend not only upon the results of penal procedure, but on that of penal execution. (9) Penal legislation, even in cases of frequent repetition of small offenses, is to place incorrigible habitual criminals beyond the possibility of doing harm for as long a time as possible.

There are 487 members in the Association, representing almost all countries of the world. The American members are: Mr. Z. R. Brockway, Rev. F. H. Wines, R. P. Falkner, Clark Bell and A. MacDonald.

We give below a short résumé of the reports of the Association for July, 1890:

Question II, c. Is it necessary and suitable to make the treatment of young criminals depend upon the distinction, whether they have acted with sufficient knowledge of their guilt? John Foinitzki, Professor of Penal Law in St. Petersburg, answers in the negative, and comes to the following conclusions: (1) This criterion is indeterminate, and leaves no sure ground for the distinction of the act, and leads to mistaken results. (2) The opinion as to the inadequacy of the criterion is more and more acknowledged; it has lost its former importance, and the work of the judge in applying it is useless. (3) Another criterion must be used which should include the general estimate of the personality of the youth; it must give ground for deciding whether the youth should come under public guardianship, and what measures are to be employed as suitable to his condition. It should be assumed that: (a) measures of punishment in the ordinary sense should not be applied; (b) it would be desirable that the passage from the procedure, determined by one court, to another, be made easy, and that this passage be looked upon as necessary, and that it correspond to the change in the individual physical condition of the young criminal.

Question II.—Is forced-labor without imprisonment adapted to take the place, in certain cases, of temporary punishment? V. J. Baumgarten, Docent in the University of Budapest, answers that forced labor without imprisonment is not a substitute for restraint upon freedom, but a substitute for a fine. With the working out of the fine, a social injustice is at the same time taken out of the world, which exposes to the economical and moral injuries from the short restraint upon freedom just that class in society which possesses the least power of resistance against injuries.

Question III.—Can and should legislation be occupied more than ever before with the element of civil reparation for the infraction of the rights of the injured party? Prof. Bernardino Alimena of the University of Naples, in answer says: At present the compensation to victims of crime is almost illusory, and without doubt the first purpose of legislation is to destroy the evil effects of crime; and if it cannot revive the victim, who has been killed, it should make the evil felt as little as possible by his sons. (a) Damages for voluntary crimes. For grave crimes, where the restrictive penalty is necessary, damages should always follow the penalty, and never be substituted for it, nor diminish it. If the criminal is solvent, he may pay with his property, and this credit will be privileged in preference to all other credits. In lesser crimes, in which imprisonment would be inutile, one can study and experiment with care. An example is given in the code of Germany which permits the penal judge to pronounce a fine in favor of the offended, to the amount of 6000 marks ($1500). (b) Damages for involuntary crimes and for cases of civil responsibility: In involuntary misdemeanors it would be necessary almost always to apply the penalty in favor of the

injured party. This penalty should not interfere with the civil damages in cases where the money paid by this penalty is not sufficient for the reparation of the damages. For the cases of non-culpability followed by civil responsibility, one cannot speak of a penalty transformable into imprisonment. The damages should be obtained in the ordinary way. A treasury for penalties should be instituted. The treasurer should pay in cases where the guilty, for a sufficient reason, *e. g.*, his death, his flight, etc., does not pay; or he should anticipate alimony in all cases where the victim is very poor and the payment will not be made soon. For this, money earned in prison should be divided into four parts: 1. For the victim until payment of the debt determined by the magistrate. 2. For the State. 3. For the coffer of penalties. 4. For the benefit of the condemned.

Question IV.—How is the incorrigibility of an habitual criminal to be determined; and what measures against these criminals are to be recommended? Prof. von Lilienthal of Marburg answers in brief: Those who have repeated relapses, from which crime appears as an outcome, are to be considered as incorrigible. Two kinds are distinguished, one resting upon hereditary taint or acquired degeneration; the other upon a criminal manner of life industrially. In answer to the second part of the question there should be: (1) Institutions for the high degrees of degeneration; (2) Institutions for the dangerous incorrigible, whether degenerated or not; these might form a special division of the present penitentiaries; (3) Work-houses for those who are not dangerous,—like the present work-houses. Perhaps they could in part be combined with them.

Internationale kriminalistische Vereinigung; Erste Landesversammlung der Gruppe deutsches Reich. Halle a. S., den 26 und 27 März, 1890.

The German division of the International Penal Association met in March, and discussed the following questions: 1. Under what presuppositions, is the introduction of the conditional sentence into German legislation expedient? 2. How is the fact of recidivation to be determined legally; and what means of punishment are to be recommended for the incorrigible? After many varied modifications, the Association finally voted on the following questions: 1. Is recidivation to be assumed if the new and former criminal act lie in the same penal grade, as designated by legislation? 2. Should recidivistic superannuation be admitted? 3. Should repeated recidivation form a necessary ground for sharpening the punishment? 4. Is a relatively increased restraint upon freedom to be recommended as a means of punishment for repeated recidivation, with the permission of imprisonment in the workhouse as a consequence? 5. Should the law touch upon regulations which ensure the permanent separation of evil-doers (considered by the penal magistrate as incorrigible), into special divisions: of prison, work-house or insane asylum? 6. Should a conditional release, after five years' detention, be granted to those considered incorrigible? The Association affirmed unanimously questions 1, 2, 3 and 6; and by a large majority questions 4 and 5. Another question was: Is it expedient to prepare jurists practically and theoretically [*i. e.*, by training in psychiatry, criminology, etc.] for the penal executive? (*a*) before; (*b*) after the States' examination. The main question was almost unanimously affirmed. After the laying aside of the subordinate question *a*, subordinate question *b* received a large majority of the votes.

Compte général de l'administration de la justice criminelle, 1887. Revue Scientifique. 8 Mars, 1890.

The official report of criminal justice in France for 1887, published in 1889, gives a good idea of French criminality. On looking at the maps

it would seem at first sight that the high degree of criminality in the large cities was due to population, but a more thorough examination shows, that it depends on ethnographical conditions. All the north and northeast of France (Normandy, Isle of France, Champagne, Picardy, Flanders) show a high criminality; below (Sarthe, Orne, Eure-et-Loir, Loiret, Yonne) a medium degree; and in the center, west and south of France criminality is feeble, with the exception of the border provinces (Basses-Pyrénées, Haute-Savoie, Savoie, Doubs, Vosges), which give a more elevated degree of criminality than the west and center of France, in which the mortality is greater than in the other provinces. The map of suicides corresponds exactly with that of criminality, except in Corsica, where there are very few. The constant progression of suicide (not special to France) deserves attention:

Year.	Absolute number.	Number per 100,000 of population.
1872	5275	15
1873	5525	15
1874	5617	16
1878	6434	17
1879	6496	18
1882	7213	19
1884	7572	20
1885	7902	21
1887	8202	21

Comparing the number of crimes from 1871 to 1887, the statistics are as follows:

	1871—75	1876—80	1881—85	1886	1887
Parricides,	10	10	14	13	23
Poisoning,	17	14	10	8	8
Assassination,	201	197	216	234	234
Infanticide,	206	194	176	166	160
Murder,	163	143	186	174	186
Unchastity,	851	899	783	712	654

Since the population from 1871 to 1887 has increased, the table shows a tendency for crime to lessen, although it is feeble. While foreigners furnish 10 per cent. of the crime, they constitute only 3 per cent. of the population. The percentage of recidivists has continually increased:

1871—75	1876—80	1886	1887
47	48	56	54

Alchoholism has diminished greatly:

1873—75	1876—80	1881—85	1886	1887
81416	75026	67155	61346	59098

In looking at the above results we are struck with the large proportion of crimes against chastity. The fact that suicide is so low in Corsica, while other crimes are numerous, suggests the law of antagonism between suicide and crimes of blood. According to these figures France (looked upon by some as a wicked country) is about the only place where crime is decreasing.

Le délit et le suicide à Brest, par le Dr. A. CORRE. Archives de l'anthropologie criminelle, 1890.

In the study of criminology, one is impressed with the continued repetition of the same offences in places widely separated; so that a thorough investigation of one locality will give much that is common to all. The author gives the results of such an investigation in a city of about 60,000 inhabitants. He is also careful to point out the local peculiarities. We give some of his conclusions: The Breton is traditional but

not atavistic; he retains many of the characteristics of his ancestors; he is a good Frenchman without ceasing to be himself. Misdemeanors have become more frequent and crimes less numerous. Measures of correction explain this in part. The return to violence in attacks on the person is explained by the recrudescence of alchoholic habits. Intemperance is a factor of a slow degeneration, which pushes to cowardly and cunning misdemeanors; is a provoker of quarrels which end in murder; it may run in the train of reviving ancient instincts of brutality. Pauperism is almost a profession; it has its saints in popular veneration. The beggar is still "*l' hôte de Dieu*"; this renders him respectable. Much whisky is consumed, and enormous quantities of absinthe, the more pernicious because very often adulterated, making it cheap, which is a principal aid in its sale. In the hospital alcoholism dominates in the etiology and in the form of the majority of the diseases. Divorces and separations are few because of distractions and mutual accommodations. You often read in the paper; "Mr. X. informs the public that he will not pay the debts of his wife." As to recidivation, drunkenness accounts for the largest part of it. Suicide, according to one school, is only a different form of the same impulsive abnormity of which crime is another form; this impulsiveness is very much allied to insanity; and as a matter of fact the three increase together from year to year. As to the influence of the seasons, one is impressed with the existence of a maximum of offences in winter, and a minimum in summer. Sometimes the cold gives the least impulsiveness to crime in January, and the heat shows its influence by increase of offences in August. Assault and battery show their maximum in February and March, and their minimum in August. Vagabondage and mendicity are parallel, having their maximum in summer, with a momentary rise in spring. Drunkenness is prevalent at all seasons, and reaches its maximum on the different holidays.

La Questione della pena di morte, per EMANUELE CARNEVALE. Torino, 1888. pp. 97.

The author treats critically in the first chapter the objections to the death penalty, and in the two following considers the matter more positively. The special question of the death penalty raises the question of penal jurisprudence in general. Individualism and its inviolability are at the basis of the theories opposed to the death penalty. But the idea of the organic unity of the individual and of society is the one to correct the errors of individualism, and emphasize rather the inviolability of the life of humanity. This is one of the principal missions of the new Italian school in criminology. Although the argument of fear from the death penalty may be over-estimated, yet it has force with the ignorant and with those who are timid among the educated classes. A second argument as stated by En. Ferri is from natural selection. The universal laws of evolution show that the progress of every living species should be in a continual selection; that in humanity, this selection, natural among the animals, should be made artificially in obedience to all the laws of life. Thus the death-penalty, like nature eliminates the individuals who do not assimilate. According to Colajanni, the voluntary element in the social organism acquires daily greater influence in comparison with the physical element, and such influence becomes always more contracting (*contrattuale*). The final argument (by Garofalo) is based on the idea of eliminative reaction; penalty is but a reaction against crime; the death-penalty is a unique and sure way of absolute elimination, hence indispensible to a full and perfect exercise of social defense. In thus eliminating those individuals, who are unadapted to society, the race is purified and an example is set. These are in brief some of the arguments mentioned by the author.

La Recidiva nei reati, studio sperimentale. GIUSEPPE ORANO. Roma, 1883, pp. 298.

The author considers recidivity theoretically in the first part of his book, and experimentally in the second part. After taking up the general notion and legislation of recidivity, and the dissention between criminologists as to the legitimacy of the threatened repression of the recidivists, he passes in the second part to the question of the aggravation of punishment in respect to age and physical conditions, and to the relations of recidivity to insanity, and comes to the following conclusions: Such ideas, as the relative insufficiency of objective physical force of punishment on account of the insensibility which the criminal opposes to it, the contempt which the guilty one manifests, the social danger which comes with the relapse, the consequent necessity of hindering this by the menace of a greater castigation, are abstract considerations, apriori criteria, bereft of the aid of positive enquiry, and consequently more hypotheses and conjectures than reasons. Thirty per cent. of the criminals in Italy are recidivists. In France, it was 43 per cent. for men and 31 per cent. for women in 1867; in Belgium at that time it was 45 per cent. and in Austria 59 per cent. for men and 51 per cent. for women, in Switzerland 45 per cent. The average shows that 45 per cent. of criminals are recidivists. The second and successive punishments are in general expiated in that period of time in which the human organism commences to lose its natural vigor; there is thus a certain aspect of injustice and inutility in punishing the recidivist. There is also a greater bitterness in a second or successive punishment between the ages of 25 and 30, the period in which recidivity is most conspicuous. As to the relation of recidivity to the carcerial system, some of the most illustrious and competent men say that about six sevenths of the men are allured into relapse. Beranger says it is the prison which makes the recidivist. The influence of surroundings can be greater or less, but it does not affect substantially the great damage done by increasing the punishment of recidivists.

Socialismo e Criminalità. ENRICO FERRI. Roma, 1883, pp. 224.

The author says in his preface to the reader, that it is imposed upon contemporary science to embrace daily reality, and not platonic researches for archeological sweepings; and that this is not the love of science for its own sake, but for the sake of life. He calls attention to two new current ideas; one is the result of the experimental method in the study of criminal phenomena, the other is the effect of positivism in the study of economical facts. His conclusions are as follows: Crime, like all other manifestations of social pathology, is the offspring of the present social system; but socialism will change radically the state of society. In the new order of things, prophesied and desired, crime will disappear (in a manner more or less absolute), and with it the relatively unproductive institutions, prisons, soldiers and judges. The social surroundings will be the best, and crime, like misery, ignorance, prostitution and immorality in general will finish their sad tyranny. The following are two general socialistic affirmations, which have immediate relation to the problem of the criminality of the future. The iron laws of the struggle for existence, which have dominated the animal world and humanity, will be eliminated from the economical order of socialism, which is the suppression of vital competition. Egoism, which in humanity, past and present, stands as a bar to all moral and social life, will disappear before altruism, disinterestedness, and love of neighbor, which will reign sovereign in the economical order of socialism.

Les Récidivistes, par JOSEPH REINACH. Paris, 1882. pp. 388.

This work is valuable, in that it gives a definite idea of the French penal system. The author describes in a forcible way the recidivistic

character. The recidivists are criminals by profession. Just because they have lost the use of understanding, they are like all the insane, a great peril to society; and it is necessary to keep them also from doing evil. Psychiatrical science and penal science are branches of the same tree, and accidental criminality bears the same relation to professional criminality that a burning fever, which is curable, does to melancholia, which is not. Yet we let loose upon society recidivists charged with ten or more condemnations. Moreover, while the insane are isolated, the criminals by profession are generally in groups, more dangerous and more menacing. In fact, that which distinguishes the recidivists from the mass of criminals, is that they are a compact army, an association opposed to society and law, incorporated to make an attempt upon the safety and property of the public. Rebels and revolters *par excellence* are the more to be feared, since they have not entered with gaiety of heart into the infernal circle, where it is necessary to renounce all hope, but have been precipitated there by misery, and almost all of them, alas, are right in accusing society, which could save them after their first false steps, but which has let them slide into the abyss without reaching a helping hand. Then it matters little that you have only to do with a feeble heart, and a soul functionally perverse. In the half-grim liberty, which the penal law has made for the recidivist, the two dangerous signs in man, habit and a taste to do evil, have become a second nature. In the degree that it would be easy to redeem him after his first fault, in the same degree it would be chimerical to attempt it now that he is in his place in the army of crime; he will not flinch; for one who deserts, ninety-nine will die impenitent on the field of battle. They are a world apart not only from honest men, but from all other criminals. The unfortunate whom misery or passion has led astray during an hour, trembles before justice, the recidivist defies it. One has not ceased to belong to society; the other has; he lacks no kind of vice; he recruits himself everywhere; with his great ally, prostitution, he is the product and the mixture of all the impure elements of society, a veritable social ulcer. The misery is terrible, no less the physical than the intellectual; his vice and debauch are monstrous, and cynical beyond conception; he has called the bench for the accused in court, "the bread-board." The main incentives to his crimes are women, wine and gambling. He is moth-eaten by the itch, which comes directly from dirtiness and privations of every nature; he is undermined by epilepsy which comes from alchoholism; he is the victim of a social order without pity; but in his turn he is the most infamous oppressor. Whatever be the cause of his hardened criminality, whatever be his own vices, misery and the logical consequences of a defective penal law are dangers to be denounced. The recidivists are dangerous because their antecedents push them to new crimes, and half of all crimes come from them. Crime produces crime, the recidivist never says *adieu* to the courts, but always *au revoir*, and on every return his crime is wiser and graver. In times of civil discord, he takes advantage of the confusion. Misery and ignorance have always been the two great causes of criminality; the number of crimes against property rises and falls with the price of wheat; the want of instruction is proportionate to the number of crimes committed. Misery and ignorance are the two aged perveyors of the courts, houses of debauch and morgues. If scarcity of bread and ignorance are the cause of the first crime, the penal code is often the cause of the second. The result of the penitentiary system is an increase of recidivists. Permanent transportation in a penitentiary colony is the only means of security against the recidivist. Patronage is the only solution of the problem of how to keep the wanderer of to-day from becoming the hardened malefactor of to-morrow, how to save the unfortunate whom abandonment leads straight to

misery, and misery in its turn fatally to crime. If the prison regime has been what it ought to be, the prisoner on his release has a desire to make a man of himself. It is just at this moment of moral convalescence, that he should be cared for and should be given employment; and if private enterprise does not do it, the state should. If after this, he refuses this aid, the social conscience is clear. When a hungry woman sells herself to have bread, society is guilty; but when a woman, who has bread, sells herself to have cake, society can follow the example of Pontius Pilate.

Criminals, by CHARLES D. SAWIN, Physician at Mass. State Prison. April, 1890. pp. 30.

This brochure is interesting as coming from the practical experience of a physician, who has been for some five years almost daily in contact with State prisoners. That all criminals are about the same and never to be trusted, whether in or out of prison, is a false conclusion. The degree of moral sense and of intellectuality should be as carefully measured by those familiar with criminals as men are measured physically by the Bertillon system, and then the criminal should be placed with those in the same approximate grade. Murderers, burglars and thieves should not be huddled together, thereby obtaining new points for their criminal career. Separating criminals into groups of the same degree of moral responsibility is preferable to the Belgian system. The hope of rendering a prison self-supporting must be given up, in order to produce the best results, *i. e.*, the stamping out of the trained criminal. Crime may be defined as the commission, by a rational being, of a certain offence or action, of which the government disapproves. It is relative; thus an inebriate instead of being put into a penal institution, may be put into a hospital. Perhaps the dealer in intoxicants will be classed as the criminal in the future. Criminals may be classified into: (1) Those having a congenital malformation or disease, either through accident or birth, or disease or vices of antecedents. (2) Criminals by circumstance, having good physical development, but insufficient will-power to withstand a propensity. And (3) criminals having a good physical development, but a constant bad environment during their lives. Although there is a greater percentage of weak-mindedness in prisons than outside, yet the tendency in major crimes, and especially where the individual is prominent, to detect evidences of mental aberration, is to be deprecated. Many prisoners become insane after entering prison; in a few instances, through remorse, or on account of the sudden change of the conditions of life, from one of pleasure to one of monotony. A little over eight tenths of one per cent. of the prison population have been transferred annually to the lunatic hospitals for treatment, for the past five years. Many more, who were harmless and quiet, could have been transferred. From a recent cursory examination, thirteen and eighteen hundredths per cent. of the prisoners in Massachusetts State Prison exhibited strong mental peculiarities; and although the major portion are very tractable during confinement under stringent rules, when permitted to mingle with the general public upon the expiration of their sentences, they fail to comprehend the social body, and break forth into some new and atrocious crime. Solitary confinement has a wonderful effect, reducing an excitable prisoner to a spirit of subjection. A certain one of this kind, when allowed the freedom of the yard was like a wild animal. He said himself that he could not bear his liberty and wanted to fight. The writer gives some interesting facts as regards Jesse Pomeroy; and closes his brochure with citations from letters written by criminals in answer to the question: "Is crime a form of insanity?" The crimi-

nals cited are decidedly of the opinion that crime is not a form of insanity; that is, five out of the six are of this opinion.

The Restoration of the Criminal, a sermon by FREDERICK H. WINES. Springfield, Illinois, 1888. pp. 22.

This sermon has more than usual value, not only for the ideas it contains, but for the facts and the confidence that may be put in them, inasmuch as the writer is the one who gathered the criminal statistics for our census of 1880. The majority of people take an optimistic or pessimistic view of crime according to their temperament, and either think that nothing can be done to stay the rising tide of crime; or else everything is done that can or ought to be. In either case they suppose that it is a matter for the government to deal with, and that private citizens have no call to waste any of their time in considering it. Many do not know how many prisons there are in our country, nor the cost of them to the community. At the time of our last census, in 1880, in all our prisons there were nearly 60,000 prisoners, and in addition 11,000 inmates of juvenile reformatories, who are virtually prisoners. Nearly ten thousand were sentenced for life, or for terms exceeding five years; they are a small fraction, and aptly compared to prisoners of war. The cost of maintaining our prisons, which is estimated at fifteen millions a year, is but a small portion of the cost of defending property and life. To this must be added another fifteen millions annually for keeping up our police departments. Then we have to maintain the ponderous and expensive system of courts. What proportion of this expense is criminal is difficult to say; but what those courts, with all their officers and employes cost us is beyond computation. Nor can the cost of the successful depredations of criminals be reckoned. We know that many individuals live by crime. Crime has its capitalists, its officers, and even legal advisers. The worst of all is, that crime is increasing in this country out of proportion to the growth of population. An examination of the reports from State prisons shows that at the present time there are over one third more convictions for high crimes in proportion to the population than there were twenty years ago.

What is the real end sought in establishing a prison? Some say: to punish crime; some, to protect society; some, to deter others from committing crime; some, to reform the criminal. There is an element of truth in each of those answers. There is a weak sentiment in society, that punishment has no place in the criminal code. We must not oppose administering justice in the spirit of retaliation in such a way as to impress others that we do not recognize the essential evil-desert of wrong-doing. At the same time, it must be admitted that the impossibility of measuring guilt in specific criminal acts, and the failure of all attempts to overcome evil with evil, have gradually changed the current of human thought, so that retaliation is not any longer the basis of an enlightened criminal code. As to protection, society has the same right as any individual in it. Fear has its legitimate use as a motive to human action. He who cannot be made to fear the consequences of evil-doing, is wrongly constituted, possibly insane, certainly void of conscience. Yet the deterrent influence of punishment upon those who experience it is greatly exaggerated. There is in human nature a propensity to self-destruction, or reckless disregard of consequences that impels men to run terrible risks to gratify passions, particularly those which are unlawful and injurious. No degree of severity will ever put an end to crime. The prison protects as long as the criminal is there; in a sense, it is a substitute for death and for banishment; but here the only sure protection is imprisonment for life; but no government will ever authorize its indiscriminate application to all grades of offenders, no matter how incorrigible they may be. There are many, even among

the officers of prisons, who oppose imprisonment for life of any man, however heinous his crime, on the ground that it deprives him of hope and reduces him to a condition resembling a living death. Further, we have no right to commit any one to a prison in which the discipline is not essentially reformatory. The worst man in liberty may fall under good influences and be changed; but to put him where influences are wholly bad, cannot be justified, especially where the sentence is for life. In any reformatory system the co-operation of the prisoner must be had. The strongest sentiment in his breast is the hope of release, and the indeterminate sentence makes the best use of this sentiment. The prisoner should be told that the date of his liberation depends upon himself, and the experienced prison officer is the one to decide this. The difficulties here are no greater than in the care of the insane. The utterly incorrigible should be put where they can do no harm as violators of law, or as teachers or examples to the young. Methods for the repression and prevention of crime should be Christian and scientific.

The Criminal, by HAVELOCK ELLIS. New York, 1890. pp. 337.

The author modestly says, that he believes there is nothing original in his book; that it simply represents a very large body of intelligent opinion in many countries. He has, however, in the introduction and conclusion well stated his own belief, resultant from a study of many and different sources. This book treats of those questions which have to do with the criminal as he is, and with society in relation to him, taking up also the practical social bearings of such studies. There are six divisions of criminals: the political criminal, criminal by passion, insane criminal, the instinctive, the habitual, and the professional criminal. The political criminal is the victim of an attempt, by a more or less despotic government, to preserve its own stability. The aims of such a criminal may be anti-social; he may try to overthrow a certain political order, which may itself be anti-social. Lombroso calls him "the true precursor of the progressive movement of humanity." From the scientific point of view, the use of the word crime to express a difference of national feeling or political opinion is an abuse of language. The criminal by passion is generally a man of wholesome birth and honest life, who under the stress of some great unmerited wrong has wrought justice for himself. For instance, if his wife be grossly insulted, he makes an attempt on the life of the offender. This species of criminal never becomes a recidivist; his crime is a solitary event in his life; he is not, therefore, dangerous to society; but he is not of advantage to society when in a moment of passion he commits his crime, and he must not complain if he produces a social reaction. The insane criminal is one, who, already in a condition of mental alienation, commits some serious anti-social act. Instinctive propensity to crime is called "moral insanity," but "instinctive criminal" is a better term; such an one is a moral monster; he does not possess guiding or inhibiting social instincts as an antidote to his strong sensual and self-seeking impulses. There is the occasional criminal, of whom weakness in resisting temptation is the chief characteristic. The occasional criminal, aided by neglect on the one hand and by the prison on the other, can develop into a habitual criminal; and by gradual steps the habitual criminal can become the professional criminal. Thus in the thefts in the Parisian shops, the Louvre and the Bon-Marché, the experience of the police shows how it begins: A woman, rich or well-to-do, buys a number of things and pays for them; but without asking permission, she takes some little, almost insignificant object, a little ribbon to fasten a parcel, a more commodious paper bag. No one will say that she is stealing. But she is observed, for one expects to see her again, some time after, taking as she walks along a flower, worth five cents say. A little later

she will appropriate something of greater value, and thereafter she will take for the pleasure of taking.

The friends of a man are startled by his great crime; but this is linked to a chain of slight occasional sporadic vices and offences. Those links can sometimes be traced out. Lebiez, in company with another French criminal, murdered an old woman in order to rob her, cutting the body up to dispose of it. The crime was prepared deliberately and carefully; a few days after it Lebiez delivered an able lecture on Darwinism and the Church. Here are the stages: (1) His violent language to his mother is remembered; (2) though with small means, he lives with a mistress and procures obscene photographs; (3) he is sent away from an institution where he gave lessons on account of irregularities; (4) he speculates on the stock exchange, which, being poor, he could only do by accepting profit and refusing to meet loss; (5) he steals books from his friends and sells them; (6) he leaves his lodgings several times clandestinely, without paying the rent; (7) he participates in stealing a watch; (8) he shows the profits of the second theft; (9) he with another decides on the murder of the old woman, whose earnings by the sale of milk were considerable. The habitual criminal is usually not intelligent, while the professional is. Lacenaire, a celebrated criminal at the beginning of this century, has been regarded as a typical professional criminal. He was born at Lyons; received a good average education; was very intelligent, though not distinguishing himself at college; he was ambitious, but incapable of sustained work; studied law in Paris, but his resources were inadequate, so became a clerk, frequently changing his situation; growing tired of work, he engaged as a soldier. So far no offence is recorded. When he returned to France, his father had become bankrupt, and fled. Friends gave Lacenaire $100 to help him. He hastened to Paris and spent it for pleasure; then he wrote verses and political articles, fighting a duel and killing his opponent. He said later that the sight of his victim's agony caused him no emotion. He might have obtained money had he cared to work steadily, but he got it by theft and swindling. Condemned to prison, he formed connections with professional criminals, adopted false names, multiplied forgeries and disguises, and preyed actively on society. After an orgy of this kind he committed murder, and attempted to murder a man who had won a large sum from him in gambling. The crime and the attempt both remained unpunished. He continued his career of crime until he met the guillotine. He was a professional, habitual, and something of an instinctive criminal.

The causes of crime can be cosmic; this includes the influences of inorganic nature, of weather; thus the increase of crimes of violence in hot weather, and the periodicity of other kinds of crime; the influence of climate and of diet. They can be biological, which head includes the personal, anatomical, physiological and psychological characteristics of the individual. There is the social factor, as treated of in criminal sociology; and with it belong the relations between crimes against the person and the price of alcohol; and crimes against property and the price of wheat. Society prepares crimes, as Quetelet said; the criminal is the instrument that executes them. "Every society has the criminals it deserves." The general conclusion of the author is, that crime is a natural phenomenon, and to be studied by natural methods, by which alone its elimination can have any chance of success.

But the public look at a criminal as a hero. In Lacenaire's case his portraits were displayed on the streets; meats and delicate wines were sent to his cell, while those driven to crime by hunger outside are but a step from him. Men of letters visited him, noted all he said, whether composed in drunkenness or given for effect; but the ladies, young, beautiful and finely attired outdid them all, desiring the honor to be pre-

sented to him; and in despair if not permitted. Lacenaire himself mocked at the infatuation he excited. They come to me, he said, "as they would ask a ticket from M. Geoffrey Saint-Hilaire to see the elephant's den." But the criminal is simply a feeble or distorted person, who has chanced, most often from lack of human help, to fall out of the social ranks. It is unreasonable and inhuman for a whole nation to become excited over him. Only education and a rational knowledge of criminality can change this sort of craze. As is well known, crime has been on the increase during the whole of the present century. In France, says Ellis, it has risen several hundred per cent.; so also for several kinds of serious crime in many parts of Germany; in Spain the number of imprisonments for life nearly doubled between 1870 and 1883; in the United States the criminal population has increased since the war relatively to the population, one third. Although certain factors may enter in to modify this real increase somewhat, yet there is a general agreement as to the fact of increase. Great Britain alone appears to be an exception; but there is a real increase in proportion to the population, in the more serious kinds of crime. Crimes of passion are rarer in the Anglo-Saxon race in England, Scotland and America than anywhere else. The decrease is in minor offences, and is due in large measure, no doubt, to reasons connected with the police.

Criminality, like insanity, waits upon civilization. Among primitive races insanity is rare; true criminality is also. Conservatism and the rigid cult of custom are as much a barrier to crime as they are to progressional civilization. When there is stress and change in social surroundings, ill-balanced natures become more frequent, and the anti-social instincts are called out more than in stagnant society. Irish criminality is far greater in England than at home. While the Americans are more criminal than the English, the criminality of the English-born in the United States is more than double that of native American whites. Thus criminality, like insanity, flourishes among immigrants, and our civilization is bringing us into the position of immigrants. But there is no reason for discouragement, for social facts, of which criminality is one, are most under our control. The problem is not isolated. It is a waste of time to talk about methods of improving criminals so long as life outside of prison makes life inside of prison a welcome shelter. So long as we foster the growth of the reckless classes we foster the growth of criminality. Thus it is that crime is *par excellence*, a sociological question.

B.—Charitological.

The relation between crime, alcoholism and pauperism is so intimate—indeed an unmixed case of any one of them is the exception—that the consideration of one involves all.

De l'Assistance, compte rendu officiel (in extenso) du congrès international tenu à Paris en 1889. 2 vols, pp. 560 and 774.

The international congress of public relief, of which this is the report, was held under the patronage of the French government at Paris from July 28 to August 4, 1889. The congress favored the guaranteeing of public relief by law to the temporarily indigent; the provision of medical attendance so far as practicable by the lowest governmental division to which the patient belongs, commune, parish, etc.; the equalization of such burdens among the governmental divisions, so that the richer communes, etc., shall help the poorer, under the general supervision of the state. Destitute children should be placed in suitable families, and the pay of those having charge of them should not be too small. The aid of disinterested women living near where the children are placed should be engaged in looking after them. Legal guardianship of children

morally abandoned is to be secured, and in their subsequent treatment some regard is to be had to the circumstances in which they are found. Places are to be provided for the care and instruction of poor children during the working hours of their parents, and special schools for those unsuited for the ordinary schools. Children that cannot be rescued by the family method should be placed in institutions where they may receive special training.

The second volume contains the reports of the four sub-sections of the congress: 1, On public relief in general; 2, On charities for children; 3, On hospitals and home relief; 4, On the insane, the poor house, etc. In Section 1 it was contended that obligatory public assistance must be justified, efficacious, preventive, and neutral in religion. In Section 2 the benefits of dispensaries to children and the public were shown, and an administrative plan for the supervision of guardianship was developed. Section 3 resolved in favor of professionally trained nurses in hospitals and better treatment of them with a view to improving the *personnel* of this branch, also schools for their training. In Section 4 Dr. Bourneville supported the establishment, by the larger governmental divisions, of institutions for defective children. Dr. Kéraval advocated provisional release of certain of the insane, under asylum supervision, for the mutual benefit of themselves and the asylums. At the suggestion of Dr. Magnan the following resolutions were voted: That the asylum should be considered as an instrument of cure and treatment; that aside from the asylum, family care and agricultural colonies should be developed as much as possible, to avoid the embarrassment of the asylums. (3). That the attending physician should indicate the classes of patients, who are in a state to receive family care, and that he should have the oversight of the agricultural colonies. At the end of the second volume is a very complete and methodical bibliography of over 300 pages on public and private assistance in France and other countries.

Die ländliche Armenpflege und ihre Reform. Verhandlungen des deutschen Vereins für Armenpflege und Wohlthätigkeit, von F. Frhr. von Reitzenstein. Freiburg, i. B., 1887. pp. 405.

The German Society for Poor Relief and Charity, has developed in detail a plan for rural poor relief. Seyffardt-Crefeld in a report on the organization of such poor relief makes the following points: 1, Legal establishment of adequate charity societies; 2, Application in the country of the principles of relief approved by experience in the city; 3, A good system of poor relief is one, which, instead of paying as cheaply as possible for temporary or continued need, strives to educate the poor to self-help, and to prevent their continued need of help; 4, The best system is the individual one, which with the co-operation of the state, guarantees a thorough treatment of every case. The conclusions of the congress as a whole have to do with matters of administration, the general aim of which seems to be to turn over to the larger communal associations those functions which call for large expenditure and technical information and to reserve for those associations which stand closer to the people needing help those functions which are individual and variable in their nature, together with sufficient financial interest to secure hearty co-operation. The larger governmental divisions can also best care for the sick and defective that are treated in institutions, and for work-houses.

Prosperity or Pauperism, edited by the EARL of MEATH, LORD BRABAZON. London, 1888. pp. 342.

Although one of the titles of this book is pauperism, a reader will find little about this subject, but a great deal concerning those reforms

in education, which would be most powerful antidotes to poverty. It is painfully obvious at present that education prepares us little for actual life. The agricultural school does not make farmers, the average college course produces a sort of non-descript or intellectual tramp. This condition of things has its influence on crime as well as pauperism. College graduates, physicians, lawyers, (and sometimes theologians even) are found in almost every prison. Poor training makes the struggle for existence more severe, and temptations to certain forms of crime more difficult to resist. The educated classes are also more sensitive to deprivations. The outcome of many of these struggles, if not suicide, is crime. This book is a republication in a cheap and popular form of recent papers on educational reforms especial prominence being given to technical education. The editor believes in physical, technical and industrial training in the common schools. The young are entitled to start in life with healthy bodies, with a knowledge of things as well as of books, with the power of using their hands as well as their heads, and of making the most of all their resources. With such reforms the future generation would find itself in a much superior position to that of the present, which being nourished mainly on intellectual food, finds its body starved and its hands paralyzed.

We may add, that, strange as it may seem, such reforms as the editor mentions, are being tested best in some penal reformatory institutions, and perhaps one of the benefits of such institutions to the state, their benefactor, is to serve as a sort of laboratory, where educational and sociological experiments can be performed and tested, as a preliminary precaution to their introduction into society in general. For if they succeed with weak men that are criminals, they ought to succeed with weak men that are not criminals.

The Tribe of Ishmael, a study in social degradation, by Rev. OSCAR C. MCCULLOCH. Reprint from the proceedings of the 15th National Conference of Charities, July 1888.

This study is an investigation, after the manner of Dugdale's "Jukes," of some of the pathological phases of pauperism. It extends over two hundred and fifty known families, thirty of which have been taken out as typical cases. The name, "The Tribe of Ishmael," is taken from the name of the central, the oldest, and the most widely ramified family. This family first appears in Indianapolis about 1840. The original family stem, of which we have scant records as far back as 1790, was then in Kentucky, having come from Maryland through Pennsylvania. Ben Ishmael had five sons and three daughters; some of the descendants are now living in Kentucky and are well-regarded citizens. One son John married a half-breed woman, and came into Indiana about 1840; he was diseased; he had seven children, of whom two were left in Kentucky; the remaining three sons married three sisters from a pauper family named Smith. These had children, of whom thirteen reared families, having sixty children, of whom thirty are now living in the fifth generation. This family has had a pauper record since 1840; having been in the Almshouse, House of Refuge, Woman's Reformatory, the penitentiaries, and has received continuous aid from the township. They are intermarried with the other members of this group, and with over two hundred other families. In the history of this family are murders, and many illegitimate children and prostitutes; they are generally diseased; the children die young. They live by stealing, begging, ash-gathering, and "gypsying" in summer; they have been known to live in hollow trees, on river bottoms and in empty houses; yet they are not intemperate to excess. A second typical case is that of the Owens family; there were originally four children of whom two have been traced, William and Brook. William had three children who

reared pauper families, in which there is much prostitution, though little intemperance. Brook had a son John, who was a Presbyterian minister. He [Brook?] reared a family of fourteen illegitimate children, ten of whom came to Indiana; their pauper record begins about 1850. Of the ten, three reared illegitimate families in the fourth generation; and of these, two daughters and a son have illegitimate children in the fifth generation. These are two typical cases; any other one of the thirty could have been taken. We start at some unknown date with thirty families. Out of 62 of the first generation, we know certainly of only three; in the second generation we have the history of 84; in the third generation, of 283; in the fourth generation (1840–60), of 644; in the fifth generation, (1860–80) of 679; in the sixth generation, (1880–90) of 57. Here is a total of 1750 persons; of these we know of 121 prostitutes and many criminals, including a number of murderers. The author shows by statistics the expense which such persons as these are to society, their physical unsoundness, their fostering by unwise charity, and points out as the things to be done: 1, Close up official out-door relief; 2, Check private and indiscriminate benevolence, or false charity; 3, Get hold of the children.

First Annual Report of the New York State Commission in Lunacy for 1889; By C. F. MacDonald, G. Brown, H. A. Reeves and T. E. McGarr, Commissioners.

A practical view of insanity, and the method of treatment from the point of view of the State, together with the difficulties involved in the combination of insanity and pauperism, is brought out in this report. The insane should be separated from other objects of the State's charities. It is improper to class the major part of the insane cared for at public expense as "pauper insane." Seventy-five per cent. of those so classed are not paupers in any true sense of the word. Insanity being a long disease, confinement being necessary, and the friends of the patient being very often not more than able to support themselves, difficulties are quite evident. The real pauper, who is insane, is not free to leave his surroundings, if they are unsatisfactory. It is evident that such cases should be treated in a specially organized hospital, that is both custodial and curative.

The reasons for the large numerical increase of insanity are: (1) a steady growth of population, and large annual influx of foreign immigration with its undue proportion of mentally defective persons; (2) a wider knowledge of insanity, which brings to light a numerous class of mild cases that formerly were not regarded as proper subjects for care; (3) realization of the fact that insanity is a disease and needs treatment; (4) the duration of insane life is greater under modern methods; (5) the reported number of admissions to asylums misleads, because some are re-admissions and others patients transferred from other institutions, (It is probable also that the baneful practice of committing recent cases to county alms-houses, where they are detained without proper treatment, either permanently or until chances of recovery have greatly lessened, increases the number); and finally, (6) much greater care is used in enumerating the insane than formerly.

Some of the recommendations of the committee are as follows: That the discharge of patients from custody be vested solely in the medical officers. That laws that divide the insane into "acute" and "chronic" be repealed; and that all insane be treated solely with reference to their curability. That the insane State paupers bear a different method of treatment from that given to the sane State paupers. That an asylum be provided for the helpless and unteachable idiots.

Notes on the Statistical Determination of the Causes of Poverty. A. G. WARNER. American Statistical Association. March, 1889.

The following are some of the conclusions of the writer: The method of case-counting is likely to exaggerate subjective influences as compared with objective; thus the immediate cause of poverty may be deterioration of character, the primary cause environment. Confusion arises also from the fact that under exactly similar conditions, some families are destitute and some not. From Mr. Booth's statistical tables of East London, we find that casual laborers comprise but 4.8 per cent. of the whole population, but more than 41 per cent. of "the very poor"; that families having female heads include 3.7 per cent. of the whole population, but furnish more than 11 per cent. of "the very poor," and more than 6 per cent. of "the poor." Mr. Booth says, that intemperance is a contributing cause in many cases where it cannot be reckoned the principal one; that the poverty of the poor is mainly the result of the competition of the very poor. The entire removal of this class out of the daily struggle for existence is the only solution of the problem of poverty. Turning to our own country, Mr. Kellogg, from figures gleaned from the reports of about forty charity organization societies in our leading cities, finds in New York and Boston, that the percentage of those needing work, rather than relief, has been 53.4, and of the unworthy, 15.8. One third of the cases actually treated were in need of material assistance, for which friendly counsel or restraint could not compensate. A logical application to the whole country is that two thirds of its real or simulated destitution could be stopped by a more perfect adjustment of the supply and demand for labor, and a more vigorous and enlightened police administration. Dugdale concludes from his study of the Jukes that environment is the primary cause, and heredity is an organized result of invariable environment.

In an article entitled "Scientific Charity," in the *Popular Science Monthly* for August, 1889, Dr. Warner illustrates the importance of the empirical method, as applied to charity. Scientific charity, as opposed to pure emotional philanthropy, regards poverty as an evil to be assailed in its causes; it does not merely pity poverty, but studies it. Thirty-four charity organization societies, representing cities containing one-eighth of our population, and probably one-sixth of its pauperism reported at the National Conference in 1887. From careful estimates, it is supposed that these cities contained about 456,000 paupers. Over 62 per cent. of this number actually came under the charge of these societies, that is, they had 57,000 families, containing about 285,000 persons, to deal with. Twenty-five of these societies agreed in classifying under four heads. By careful analysis of nearly 28,000 cases, including over 100,000 persons, the results were as follows:

Those needing continuous relief,	10.3 per cent.
" " temporary "	26.6 " "
" " work rather than relief,	40.4 " "
Unworthy of relief,	22.7 " "

As an example of the value of more elaborated figures, the results of the Buffalo society are given, on a basis of 1407 families, including 5388 persons. The chief cause of destitution was lack of employment in 263 cases; sickness in 326; no male support in 373; intemperance in 124; physical defects in 113; insufficient earnings in 87; accidents in 45; imprisonment of bread-winner in 35; shiftlessness in 26; and insanity in 15. Out of these 1407 destitute families, the respective heads of 1019 of them could both read and write; 49 others could read, but not write; and 339, or 24 per cent. were wholly illiterate. It is interesting to recognize that by this method, the philanthropist, with the principle of enlightened self-sacrifice finds himself in accord with the economist, with his enlightened self-interest.

Endowed Charities. COURTNEY KENNY. London, 1880. pp. 280.

One of the objects of the author is to make his book useful as well to politicians, who may take part in charitable reforms, as to charity trustees or benevolent persons, who in planning charitable gifts, may desire to enhance their liberality by a wise prescience. The materials are taken chiefly from the Blue-books of the last sixty years. The conclusions of the author are: That endowed charities have done more good than harm, and should be encouraged. Foundations in themselves are usually good, but left to themselves, usually become bad; there must be constant supervision and periodical revision. The one will restrain the principle of caducity, the other will counteract the principle of obsolescence. A considerable minority of foundations either spring from a bad origin or tend to a bad result. Lest this minority should be increased, the law must impose certain restrictions on the establishment of new foundations.

The Tramp at Home, by LEE MERIWETHER. New York, 1889.

The author has spent some time in the old world as well as in the new, in gathering labor statistics. The results of investigations in this country are given in this book. But the dry figures are clothed with incidents, amusing and otherwise, that befell the author in his intercourse with the working classes. Although the book is popular in its style, yet it is not without interest to a more serious study of sociological questions. The author seems to consider present society as in an abnormal state; and, however one may regard this point of view, he is still made conscious of how all questions of social pathology (crime, pauperism, etc.) are inseparably linked together. The sociologists and statisticians show the crowded condition of the poor in cities, low wages, high cost of living, and sewing and saleswomen working fourteen and sixteen hours a day for pittances scarcely sufficient to support life. The working men are generally told, in order to be happy and prosperous that they should organize, co-operate, be educated, practice temperance, economy and industry. To these admonitions in themselves there are no objections. But they are all makeshifts; they only remedy evils already created, but do not go to the heart of the matter and seek to prevent the evil. When women that are sober, intelligent and economical, work from early morning till late at night, and still actually hunger for bread, the plea that education, temperance and economy are the preventives, falls to the ground. Why will sewing-women, cloak-makers, and others, work for three dollars a week? Is it not because of the over-supply of labor? Because our cities are teeming with unemployed labor? The problem primarily resolves itself into that of counteracting and preventing abnormal concentration of population in cities. In 1780 less than a thirtieth of our population lived in cities of eight thousand and over. In 1880, nearly one-fourth of the population lived in cities of eight thousand and over. The Federal Government has said to the farmer, for a great part of our national existence, manufacturing is not profitable; farming pays well; we will take part of your profits to make up the manufacturer's deficit. This puts a premium on manufacturing (going to cities) and a penalty on farming, which has become unprofitable; so the farmers move into the city and increase the competition. The first preventive then is to cease governmental premiums to cities and penalties to farmers. The second preventive is a graduated land-tax, with its expected train of benefits. The day will come, says the author, when every citizen will be able to retain and enjoy the wealth he himself has created. In that day both the billionaire and the tramp will go.

Scientific Charity, by MRS. GLENDOWER EVENS, Conference of Charities and Correction, 1889.

This paper gives many practical suggestions as to the meaning and methods of scientific charity and the working of Charity Organization Societies. When the wise methods here described shall have become the common property of the people, as they are now of specialists in charitology, charity will at last be both sane and kind.

Social Problems. DANIEL CLARK, M. D. Address read before the Association of Executive Health Officers of Ontario, Aug. 17, 1888.

We have here a doctor's views on very practical questions plainly stated. He speaks of tramps, divorce, the selection of proper partners in wedlock, prostitution and diseases which attend it, and lastly inebriety. The unanimity with which the need of some remedy would be acknowledged would probably equal the diversity of opinion on some of the remedies suggested, though none of them are unheard of. The doctor does not hide his belief that the short-livedness of drunkards and criminals is a beneficent elimination of the unfit, and, since in a degree they attain the pleasure at which they aim, not so very hard upon them either.

C.—ALCOHOLOGICAL.

Inebriism, a pathological and psychological study. T. L. WRIGHT, M. D. Columbus, O., W. G. Hubbard, 1885. pp. 222.

To the credit of American physicians and the discredit of American citizens, the study of "Inebriism" is here no novelty. Among those who have been active in bringing about a rational conception of Inebriety as a disease, and of special hospital treatment as a cure, Dr. Wright holds a prominent place. In this book he sets forth in fashion to be understood by the non-professional reader, the information which the neurologist and alienist has to contribute to the effect of alcohol on the nervous system and the mind. The book is not hortatory, but expository, and therefore the more effective; the author is at more pains to show the limited responsibility of the drunkard than to fix the responsibility for his condition. In the inebriate, as in the sufferer from cerebral disease, nature is making experiments in physiological psychology for all to see, and the psychologist will find matter of interest in Dr. Wright's analyses and in the cases which he cites in illustration.

L' ivress au congrès pénitentiaire de Saint-Pétersbourg. Revue de l'hypnotisme, 1er juillet, 1890.

The following resolutions, coming from an International Congress, may indicate, to some extent, the general consensus of opinion in Europe, as to drunkenness. The fourth International Penological Congress, which assembled in July, 1890, considered the question of inebriety and penal legislation. After a long discussion of six sittings, the first section of the congress presented the following resolutions, which had been adopted by the Congress in its general meeting, the 19th of June: 1. Drunkenness considered in itself would not constitute an offense; it gives cause for repression only when manifested publicly, in dangerous conditions to security, or by acts of a scandalous nature, or likely to disturb the peace. 2. Legislative action is useful in the care of drinkers who become a charge on public benevolence, dangerous to themselves or others. 3. Licensed dealers should be made penally responsible for the sale of strong liquors to persons manifestly drunk. 4. In case of offenses committed in drink: (*a*) The state of drunkenness does not complete, nor in any case exclude responsibility; this state cannot be defined by the legislator as an attenuating or aggravating circumstance,

but its influence depends on each particular case. (*b*) The state of drunkenness does involve responsibility, at least before the law, in the following cases: (a) when drunkenness constitutes by itself a penal offense; and (b) cases of *actiones liberas in causa*, when a person becomes drunk knowing that in the state of inebriety he will or can commit a crime; in the first case, he renders himself responsible for an offense committed with premeditation; in the second case, for an offense committed by negligence.

De la dipsomanie et son traitement par la suggestion, par le Dr. EDG. BÉRILLON, Revue de l'hypnotisme, août, 1890.

The treatment and cure (temporary at least) of one who has been a hard drinker for fifteen years, is a case in hypnotic therapeutics worthy of consideration. We extract points from the writer's lecture. Patient 35 years old, robust, muscular, intelligent, successful in business; parents sober and healthy. Learned to drink in the army, drinking wine and whiskey, sometimes in considerable quantity, but without drunkenness. On leaving the army he exchanged whiskey for absinthe; his business, which involved travelling, encouraged his drinking, but he had little inclination to drink when at home. At last, signs of physical trouble appeared, together with nightmare, hallucination, delusion of persecution, and idea of suicide. These returned every month or two with irresistable craving for drink, which scattered his good resolutions. He was also an inveterate smoker. On May 3, 1888, he was hypnotized, and dreamless sleep and total abstinence from liquors and tobacco were suggested. The suggestion was successful. He was under treatment from May 3 to May 15, the hypnotization and suggestion being repeated daily at first. By degrees physical troubles were helped and his desire to drink and smoke removed. He found himself able to resist under circumstances in which before he would have inevitably yielded. On May 15 he was pronounced cured and discharged. After thirteen days of treatment, without isolation, continuing to walk the streets of Paris, he saw all his physical and mental troubles successively disappear, and his inveterate habit of drinking and smoking cease.

Hérédité et alcoolisme. Dr. LEGRAIN. Revue de l'hypnotisme 1er Mars, 1890.

There are three main characteristics in alcoholism: the mental state, the impulsions and the tendency to delirium at the slightest cause. The degenerate are more susceptible than those who are of well-balanced mind. Alcoholic delirium differs in its symptoms from that of drinkers with no defects. In hereditary cases drunkenness comes in a short time; once started it assumes forms which recall its nature and predisposition. Alcoholic delirium of the predisposed does not resemble that of the stereotyped delirium. The rigors of intoxication and the rigors of hereditary predisposition have a certain independence. The slowness of evolution, frequence of relapsing, feebleness of mental faculties, polymorphism of delirium characterize the alcoholism of the degenerate. Inveterate abuse of drinking in non-hereditarily disposed persons creates a degeneracy like the hereditary. Organic physical resistance diminishes as excess increases. Alcohol causes its special delirium; little by little it simply plays the roll of an *appoint*. In a large number of cases the man is not free not to drink.

La responsabilité des alcooliques. M. MOTET. Revue de l'hypnotisme, 1er août, 1889.

There is no fixed jurisprudence in France as to responsibility in alcoholism. In civil matters alone, when drunkenness of the contracting party has been established at the time of the contract, the contract is

annulled. Drunkenness has in these conditions been made like to a state of dementia. One class comprehends simple drunkenness, accidental or provoked, and in some cases premeditated. To this class belong drinkers by habit, who without showing the troubles characteristic of drunkenness, are always under the influence of alcohol. A second class concerns all forms of pathological drunkenness, partially acute or acute mental troubles, or chronic troubles due to intoxication. In this class are the insane, imbecile, epileptic, whom alcoholic excess can lead to the most dangerous acts, by awakening impulsive tendencies which otherwise would not be awakened. Drunkenness is punishable as well as crimes committed under its influence, when the delinquent has the power to avoid it; when the alcoholic excitation has been sought in order to give one enough determination to commit a crime. Drunkenness is punishable in an attenuated degree in cases of feeble intelligence, in which intolerance for liquor is shown by an inferior cerebral organization; they are not excusable when they know they cannot drink without danger; such cases are more numerous than is generally supposed. Crimes cannot be punished if committed during an acute or sub-acute period of delirium in an alcoholic paroxysm. It is also the same in chronic alcoholism, when cerebral lesions have affected the integrity of the organ. The individual should be put under treatment.

The Public and the Doctor in Relation to the Dipsomaniac, by Dr. DANIEL CLARK. Toronto, 1888. pp. 20.

The writer brings out clearly the sociological side of alcoholism, showing how the State is responsible for many of its drunkards. He mentions a practical and suggestive prophylaxis. There are four classes of drunkards: 1. Those who drink from a habit of tippling; 2. Those who drink to relieve nervous prostration, or to drown sorrow or wrong; 3. Those who drink from hereditary tendency; 4. Traumatic drunkards. The tipplers are usually of three kinds: a, The weak-willed; b, The genial; c, The mean-souled man, who delights to "sponge" on others. Those who become drunkards by nightly potations to relieve mental trouble are more numerous than supposed. This drunkenness has no excited stage, and the habit may go on without being noticed for years. The nocturnal drunkard will take a small dose in the morning to throw off the stupidity of the nightly debauch and to appear as usual before the public. But this has its limits, and paralysis, apoplexy or insanity may result. This class usually belongs to our active members of society. Such nightly stupefactions are more fatal to mental integrity than any other form of drinking. In heredity it is the nervous bias which is transmitted, which can be aroused suddenly or may lie latent for years. The paroxysms come intermittently, like the periodic insanities. The hereditary foe may be overcome by daily battles, but not by isolated ones. Persons of this class have an unusually nervous condition, irregular circulation, low nutrition, morbid fears, irritable temper, lack of resolution (foreign to the individual in health); even misconceptions and delusions may supervene when the attack is coming on. During these bouts of drinking mania the man is uncontrollable. We may eliminate from the large number of defectives in society those who could reform if they would only try, but yet a large number remain, on whom no influence, social or religious, has any effect. There is no help for those but enforced restraint in special asylums, where they can have work, air, amusement and homelike treatment. These should be as unprisonlike as possible, and the State should provide them. The author, apparently is not averse to prohibition, and failing that would have the revenue from licenses devoted to the care of the inebriates produced.

IV.—PSYCHIATRY.

The Insanity of Jean Jacques Rousseau.

William Noyes, M. D.

J. J. Rousseau's Krankheitsgeschichte. P. J. Möbius. Leipzig, F. C. W. Vogel, 1889.

Rousseau. John Morley. London, Macmillan & Co., 1886.

The Confessions of J. J. Rousseau. Hédouin Edition.

The part played by mental disease in religion in the past has been a tremendous one, and is coming to be recognized more year by year, but the part that insanity has taken in political movements, although it has been considerable, has not been so well understood. In Rousseau the two rôles of reformer in religion and in politics were united as perhaps they have been in no other one individual, for we are still in ignorance of what will be the end of that battle for human freedom which began under his leadership over a century ago. That Rousseau was insane is generally, if not universally admitted, but the period of disease is usually limited to the latter years of his life when the disorder became patent to every one from his accusations against Hume. That Rousseau was insane all his life might be thought a thesis impossible to maintain; but as a matter of fact, his life as set forth in the Confessions and Reveries, with the side lights thrown on these by other writers and commentators, forms as perfect a clinical picture of a well recognized form of mental disease as there is in literature. The literature of psychiatry in itself contains nothing that approaches this in accurate description of symptoms, analysis of character, and the persecutions suffered by a chronic lunatic.

During the past few years there has been a great and rapid increase of Rousseau literature, as more and more attention has been paid to the remote causes of movements that are now going on among us.

Dr. Möbius has written the history of Rousseau's disease more fully than it has ever been written before, and has given the story of the evolution of his malady from its very beginnings. His book is of special interest to the alienist, as he discusses many points of a purely medical interest. Mr. Morley has also written a history of Rousseau's disease, which is all the more valuable because of the author's ignorance that the details he gives and the criticisms he makes tell with such deadly force against his subject. Morley protests that he does not wish to turn poor Rousseau over to the pathologists too soon, but in fact he turns him over to them from the moment of his birth. It is but fair that before we make Morley turn pathologist we should give him a chance as historian to state the case for Rousseau, and he does this so vigorously and so brilliantly that all must acknowledge the debt that humanity is under to the poor sufferer.

"The Revolution is now the accepted name for a set of changes which began faintly to take a definite practical shape, first in America and then in France, towards the end of the eighteenth century; they had first been directly prepared by a small number of energetic thinkers, whose speculations represented, as always, the prolongation of some old lines of thought in obedience to the impulse of new social and intellectual conditions. . . . . Rousseau was the most directly revolutionary of all the speculative precursors, and he was the first to apply his mind boldly to those of the social conditions which the revolution is concerned by one solution or another to modify. How far his direct influence was disastrous in consequence of a mischievous method we shall

have to examine. It was so various that no single answer can comprehend an exhaustive judgment. His writings produced that glow of enthusiastic feeling in France, which led to the all-important assistance rendered by that country to the American colonists in a struggle so momentous for mankind. It was from his writings that the Americans took the ideas and the phrases of their great charter, thus uniting the native principles of their own direct protestantism with principles that were strictly derivative from the protestantism of Geneva. Again, it was his work more than that of any other one man, that France arose from the deadly decay that had laid hold of her whole system, and found that irresistable energy that warded off division from within and partition from without. We shall see, further, that besides being the first immediately revolutionary thinker in politics, he was the most stirring of reactionists in religion. His influence formed not only Robespierre and Paine, but Chateaubriand, not only Jacobinism, but the Catholicism of the Restoration. Thus he did more than any one else at once to give direction to the first episodes of revolution, and force to the first episode of reaction. . . . . The personality of Rousseau has most equivocal and repulsive ideas. It has deservedly fared ill in the esteem of the saner and more rational of those who have judged him, and there is none in the history of the famous men and our spiritual fathers who begat us, who makes more constant demands on the patience or pity of those who study his life. Yet in no other instance is the common eagerness to condense all predication about a character into a single unqualified proposition so fatally inadequate. . . . . We may forget much in our story that is grievous or hateful, in reflecting that if any man now deems a day basely spent in which he has given no thought to the hard life of garret and hovel, to the forlorn children and trampled women of wide squalid wildernesses in cities, it was Rousseau who first in our modern time sounded a new trumpet note for one more of the great battles of humanity. It was in Rousseau that polite Europe first harkened to strange voices and faint reverberations from out of the vague and cavernous shadow in which the common people move. Science has to feel the way towards light and solution, to prepare, to organize; but the race owes something to one who helped to state the problem, writing up in letters of flame at the brutal feast of kings and the rich that civilization is as yet only a mockery, and did furthermore inspire a generation of men and women with the stern resolve that they would rather perish than live in a world where such things can be."

Humanity is indeed under a great debt to the man of whom all these things are true, and it will help us to a more charitable view of him to study the conditions under which he did his work, and how handicapped he was from his birth. Morley tells Rousseau's life-history so vividly, and analyzes and sums up his character so justly, that we shall allow him to tell the story in large part, with comments from time to time on what the signification is to the mental pathologist.

Jean Jacques Rousseau was born in Geneva in 1712. His mother was the daughter of a Geneva minister; she was possessed of much sensibility, was fond of drawing and music, was well read and made verses. "I cost my mother her life," wrote Rousseau, "and my birth was the first of my woes." The child was born dying, and was saved only by the affectionate care of a paternal aunt, but his constitution remained infirm and disordered. There was no known tendency to mental disease on his mother's side; but on the father's side there was an hereditary taint. Rousseau was born with a congenital malformation of the bladder, but Möbius does not think that this can with certainty be looked on as a sign of degeneration. There is no evidence of any other signs of physical degeneration. "The father of Rousseau," says Morley, "was unfortunately cast in the same mould as his mother, and the child's own

morbid sensibility was stimulated and deepened by the excessive sensibility of his first companion. . . . . Isaac Rousseau's restlessness, his eager emotion, his quick and punctilious sense of personal dignity, his heedlessness of ordered affairs, were not common in Geneva, fortunately for the stability of her society and the prosperity of her citizens. This disorder of spirit descended in modified form to the son; it was inevitable that he should be indirectly affected by it. Before he was seven years old he had learnt from his father to indulge a passion for the reading of romances. The child and the man passed whole nights in a fictitious world, reading to one another in turn, absorbed by vivid interest in imaginary situations until the morning song of the birds recalled them to a sense of the conditions of more actual life, and made the elder cry out in confusion that he was the more childish of the two."

"I had no idea of real things," Rousseau wrote, "though all the sentiments were already familiar to me. Nothing had come to me by conception, everything by sensation. These confused emotions striking me one after another, did not warp a reason that I did not yet possess, but they gradually shaped in me a reason of another cast, and gave me bizarre and romantic ideas of human life, of which neither reflection nor experience has ever been able wholly to cure me."

After the romances they read Plutarch, Tacitus and Ovid, and Rousseau, at the age of ten, actually conceived himself to be the Greek or Roman hero of whom he read. That his after life was ever clouded by the evil knowledge he acquired at school, and by the abnormally early birth of the passions, must be freely admitted. But his school life is also memorable in an agreeable manner, for it is possible to trace back to that period his resistance to injustice and wrongful suffering. He was placed under suspicion of having broken the teeth of a comb that did not belong to him. Severe punishment followed, but without bringing out an untrue confession of guilt. "The first sentiment of violence and injustice has remained so deeply engraved on my soul that all the ideas relating to it bring my first emotion back to me; this sentiment, though only relative to myself in its origin, has taken such consistency and become so disengaged from all personal interest, that my heart is inflamed at the sight or story of any wrongful action, just as much as if the effect fell on my own person. When I read of the cruelty of some ferocious tyrant, or the subtle atrocities of some villain of a priest, I would fain start on the instant to poinard such wretches, though I were to perish a hundred times for the deed. . . . . This movement may be natural to me, and I believe it is so; but the profound recollection of the first injustice suffered was too long and too fast bound up with it, not to have strengthened it enormously. . . . . Here was the term of the serenity of my childish days. From this moment I ceased to enjoy a pure happiness, and I feel even at this day that the reminiscence of the delights of my infancy comes to an end. . . . . Even the country lost in our eyes that charm of sweetness and simplicity which goes to the heart; it seemed sombre and deserted, and was as if covered by a veil, hiding its beauties from our sight. We no longer tended our little gardens, our plants, our flowers. We went no more lightly to scratch the earth, shouting for joy as we discovered the germ of the seed we had sown."

"Whatever may be the degree of literal truth in the confessions," says Morley, "the whole course of Rousseau's life forbids us to pass this description by as overcharged or exaggerated. We are conscious in it of a constitutional infirmity. We perceive an absence of healthy power of resistance against moral shock. Such shocks are experienced in many unavoidable forms by all save the dullest natures, when they first come into contact with the sharp tooth of outer circumstance. . . A vehement objective temperament like Voltaire's is instantly roused

by one of these penetrative stimuli into angry and tenacious resistance. . . . . A sensitive or depressed spirit like Rousseau's or Cowper's finds itself without any of these reacting kinds of force, and the first stage of cruelty or oppression is the going out of a divine light."

It would be hard to find, outside a treatise on insanity, a better description of the neuropathic temperament that foredooms its possessor to a life of unstable equilibrium and almost inevitable mental disease.

After leaving school he spent three years with an uncle in Geneva, losing his time for the most part, but learning something of drawing and something of Euclid.

At the age of eleven he was placed in a notary's office, but was dismissed by his master for dullness and inaptitude; being pronounced stupid and incompetent past hope by his fellow clerks. He was next apprenticed to an engraver. The roughness and coarseness of this man completely demoralized Rousseau, and he sank into a moral slough, telling lies, pilfering things to eat, using his master's best tools by stealth. His master was very cruel, and punishments for these offences produced an overmastering physical horror. In his sixteenth year he ran away.

Making his way to Savoy, he was kindly received by a Catholic priest who was an active proselyter. Rousseau agreed to receive instruction in the matters of the Catholic religion, and was sent by the priest to a Madame de Warens, who in her turn sent him to a monastery in Turin, where, exactly nine days after his admission, he "abjured the errors of the sect." The interest of the priests ended with his conversion, and he was set adrift with twenty francs. His wanderings do not concern us, but one incident throws a lurid gleam on his moral condition at this time. He had been a footboy in the household of a widow, and on her death a piece of ribbon was missing; Rousseau had stolen it, and it was found in his possession, but he accused a young maid of giving it to him, and repeated the story in her presence before the whole household. The dread of suffering was doubtless the cause of this baseness, but it shows the extent of the degeneration that was going on within him. He afterwards lamented greatly his unjust accusation, and as usual probably overestimated the evil that befell the maid in consequence of his accusation. A period of six weeks' wandering followed, when he obtained another position as lackey, but was dismissed for reckless neglect of duty. Once more he becomes a vagrant, and in the company of a companion starts homeward. Morley quotes Rousseau as saying, in words which shed more light on darker parts of his history than fits of vagrancy,—"To understand my delirium at this moment it is necessary to know to what a degree my heart is subject to get aflame with the smallest things, and with what force it plunges into the imagination of the object that attracts it, vain as this object may be. The most grotesque, the most childish, the maddest schemes come to caress my favorite idea, and to show me the reasonableness of surrendering to it."

Rousseau's youth properly ends here. His wanderings ended by his being received again by Madame de Warens, and the history of his connection with her belongs to his biography and not especially to the history of his disease, except that all that followed while he was with her was made possible by his temperament and by the vacillating weakness, emotionality and sensibility shown in his growth from boyhood to youth.

We shall let Morley characterize him at this period, just before he comes under the influence of Madame de Warens: "A vagrant sensuous temperament, strangely compounded with Genevese austerity; an ardent and fantastic imagination, incongruously shot with threads of firm reason; too little conscience and too much; a monstrous and diseased love of self, intertwined with a sincere compassion and keen interest for the great fellowship of his brothers; a wild dreaming of

dreams that were made to look like sanity by the close and specious connection between conclusions and premises, though the premises happened to have the fault of being profoundly unreal: this was the type of character that lay unfolded in the youth who towards the autumn of 1729 reached Annecy, penniless and ragged, throwing himself once more on the charity of the patroness who had given him shelter eighteen months before. Few figures in the world at that time were less likely to conciliate the favor or excite the interest of an observer who had not studied the hidden convulsions of human character deeply enough to know that a boy of eighteen may be sly, sensual, restless, dreamy, and yet have it in him to say things one day which may help to plunge a world into conflagration."

The years with Madame de Warens were the formative ones of his life. Here he acquired his knowledge of books, of the lives of the poor, and of the world's way with them. "Above all his ideal was revolutionized, and the recent dreams of Plutarchian heroism, of grandeur, of princesses, and of a new career full in the world's eye were replaced by a new conception of blessedness of life which never afterwards faded from his vision, and which has held a front place in the imagination of literary Europe ever since."

Rousseau was with Madame de Warens, including various intervals, until April, 1740. His mental condition during this time offers nothing especially noteworthy. The connection with Madame de Warens was broken off permanently when Rousseau was 28. Möbius places the first real outbreak of insanity in 1766, when Rousseau was 54, and last twelve years until his death in 1778. The twenty-six years between 1740 and 1766 we may pass over with but one or two references to his mental condition. The first thing to note is the ease with which he placed his five children by Theresa le Vasseur in the foundling asylum, one after another. Möbius refrains from passing any judgment on these acts or their motives. In late years Rousseau tried to remedy this defect, but it was too late.

The circumstances under which he wrote many of his works are especially worthy of note in a study of his mental condition. First came the essay which gained the prize from the Academy of Dijon, *Has the restoration of the sciences contributed to purify or corrupt morals?* Walking in the road one day he saw in a newspaper the announcement of the theme propounded by the Dijon academy. "If ever anything resembled a sudden inspiration, it was the movement that began in me as I read this. All at once I felt myself dazzled by a thousand sparkling lights; crowds of vivid ideas thronged through my mind with a force and confusion that threw me into unspeakable agitation. I felt my head whirling in a giddiness like that of intoxication. A violent palpitation oppressed me; unable to walk for difficulty of breathing, I sank under one of the trees of the avenue, and passed half an hour there in such a condition of excitement that when I arose I saw that the front of my waistcoat was all wet with tears, though I was wholly unconscious of shedding them. Ah! if I could ever have written the quarter of what I saw and felt under that tree, with what clearness should I have brought out all the contradictions of our social system; with what simplicity I should have demonstrated that man is good naturally, and that by institutions only is he made bad."

This was years before the outbreak of insanity that was noticeable to all the world; but we here see another well marked sign of the neuropathic constitution. Rousseau's literary activity began with this ecstatic vision at the foot of the oak. Morley, who devotes more space to the incident than Möbius, admits that "such a transport does not come to us of cool and rational western temperament, but more often to the oriental after lonely sojourning in the wilderness, or in violent reactions

on the road to Damascus and elsewhere. Jean Jacques detected oriental quality in his own nature, and so far as the union of ardor with mysticism, of intense passion with vague dream is to be defined as oriental, he assuredly deserves the name. The ideas stirred in his mind by the Dijon problem suddenly 'opened his eyes (it is Rousseau himself who is speaking), brought order into the chaos of his head, revealed to him another universe. From the active effervescence which this began in his soul came sparks of genius which people saw glittering in his writings through the ten years of fever and delirium, but of which no trace had been seen in him previously, and which would probably have ceased to shine henceforth if he should have chanced to wish to shine after the access was over. Inflamed by the contemplation of these lofty objects he had them incessantly present in his mind. His heart, made hot within him by the idea of future happiness of the human race, and by the honor of contributing to it . . . . dictated to him a language worthy of so high an enterprise . . . . and for a moment he astonished Europe by productions in which vulgar souls saw only eloquence and brightness of understanding, but in which those who dwell in the ethereal regions recognized with joy one of their own.'"

Rousseau counted this moment as the ruin of his life, and that all his misfortune flowed from this, and it may be that there were saner moments in which he recognized that here was the beginning of the trouble that afterwards completely shadowed his life.

For the next thirteen years he was completely mastered by his visions, and almost all his works were written under the influence of such ecstasies as he has described.

From 1744 to 1756 he was in Paris, and during this period his mental disease seems to have advanced but little. He had a position as a cashier in the receiver-general's department. Having an illness which his physicians thought would end fatally in six months, he threw up a position which would in time have made him rich, and undertook to gain his living by copying music. During this period he was reconverted to protestantism.

A new period of his life is marked by his residence at the Hermitage (1756), which was fitted up for him by Madame d'Epinay. Rousseau was never at home in the city,—"having (in Paris) been fifteen years out of my element,"—and his return to the country filled him with transports of delight. His arrival brought on what he truly called a "rural delirium," lasting some days, in which he was not able to do any work. "My very first care was to surrender myself to the impression of the rustic objects around me. Instead of beginning by arranging things inside my quarters I first set about planning my walks, and there was not a path, nor a copse nor a grove round my cottage which I had not found out before the next day." On attempting to work, he found this impossible; he was in such a state of exaltation due to his change to the country. "This exaltation was in a different direction from that which had seized him half a dozen years before, when he had discarded the usage and costume of polite society, and had begun to conceive an angry contempt for the manners, maxims and prejudices of his time. Restoration to a more purely sensuous atmosphere softened this austerity. No longer having the vices of a great city before his eyes, he no longer cherished the wrath which they had inspired in him. 'When I did not see men I did not despise them, and when I had not the bad before my eyes I ceased to hate them. My heart, little made as it was for hate, now did no more than despise their wretchedness and their badness. This state, so much more mild if less sublime, soon dulled the glowing enthusiasm that had long transported me.' That is to say, his nature remained for a moment not exalted but fairly balanced. And in studying the movements of impulse and reflec-

tion in him at this time of his life, we are hurried rapidly from phase to phase. Once more we are watching a man who lived without either intellectual or spiritual direction, swayed by a reminiscence, a passing mood, a personality accidentally encountered, by anything except permanent aim and fixed objects, and who would at any time have surrendered the most deliberately pondered scheme of persistent effort to the fascination of a cottage slumbering in a bounteous landscape. Hence there could be no normally composed state for him; the first soothing effect of the rich life of the forest and garden on a nature exasperated by the life of the town passed away, and became transformed into an exaltation that swept the stoic into space, leaving sensuousness to sovereign and uncontrolled triumph, until the delight turned to its inevitable ashes and bitterness."

These ecstacies usually took place in the woods, where, accompanied by his dog, he used to go "in search of some wild and desert spot in the forest, where there was nothing to show the hand of man or to speak of servitude and domination; some refuge where I could fancy myself its discoverer, and where no inopportune third person came to interfere between nature and me. My imagination did not leave the earth thus superbly arrayed without inhabitants. I formed a charming society of which I did not feel myself unworthy; I made a golden age to please my own fancy, and filling up these fair days with all the scenes of my life that had left sweet memories behind, or all that my heart could yet desire or hope in scenes to come, I waxed tender even to shedding tears over the true pleasures of humanity, pleasures so delicious, so pure, and henceforth so far from the reach of man. Ah, if in such moments any ideas of Paris, of the age, of my little aureole as author, came to trouble my dreams, with what disdain did I drive them out, to deliver myself without distraction to the exquisite sentiments of which I was so full. Yet in the midst of it all, the nothingness of my chimeras sometimes broke sadly upon my mind. Even if every dream had suddenly been transformed into reality it would not have been enough; I should have dreamed, imagined, yearned still."

He conceived several literary schemes after the first fermentation which followed his arrival was over, but gave them up one after another, and although the effort was partly successful, it was followed by a severe and prolonged crisis. "The impossibility of reaching to real beings plunged me into the land of chimera, and seeing nothing actual that rose to the height of my delirium, I nourished it in an ideal world, which my creative imagination had soon peopled with beings after my heart's desire. In my continual ecstasies, I made myself drunk with torrents of the most delicious sentiments that ever entered the heart of man. Forgetting absolutely the whole human race, I invented for myself societies of perfect creatures, as heavenly for their virtues as their beauties; sure, tender, faithful friends, such as I never found in our nether world. I had such a passion for haunting this empyrean with all its charming objects, that I passed hours and days in it without counting them as they went by; and losing recollection of everything else, I had hardly swallowed a morsel in hot haste, before I began to burn to run off in search of my beloved groves. If, when I was ready to start for the enchanted world I saw unhappy mortals coming to detain me on the dull earth, I could neither moderate nor hide my spleen, and, no longer master over myself, I used to give them greeting so rough that it might well be called brutal."

An attack of physical disease happily brought these raptures to a close for the time. "The moment he could get out of doors again into the forest," says Morley, "the transport returned, but this time accompanied with an active effort in the creative faculties of his mind to bring the natural relief to these over-wrought paroxysms of sensual

imagination. He soothed his emotions by associating them with the life of personages whom he invented, and by introducing into them that play and movement and changing relation which prevented them from bringing his days to an end in malodorous fever. His thought became associated with two female figures, one dark and the other fair, one sage and the other yielding, one gentle and the other quick, analogous in character but different, not handsome but animated by cheerfulness and feeling. To one of these he gave a lover, to whom the other was a tender friend. This vicarious or reflected egoism, accompanied as it was by a certain amount of productive energy, seemed to work a return to a sort of moral convalescence. He walked about the groves with pencil and tablets, assigning this or that thought or expression to one or other of the three companions of his fancy." When the winter came on he was confined to the house by the bad weather, and he attempted to resume his music copying and the compilation of his Musical Dictionary, but he found this impossible, as he could see nothing but the three figures and the objects about them made beautiful by his imagination. He could not dismiss them and resistance was vain, so he began arranging his thoughts "so as to produce a kind of romance." He could not write his romance on anything but the finest paper with gilt edges; the powder with which he dried the ink was of azure and sparkling silver, and he tied up the quires with delicate blue ribbon. Morley admits that the distance of all this from a state of nature is very great indeed. Rousseau appeared fully to recognize his inconsistency in writing a love romance; "after the severe principles I had just been laying down with so much bustle, after the austere maxims I had preached so energetically, after so many biting invectives against the effeminate books that breathed love, could anything be imagined more shocking, more unlooked for, than to see me inscribe myself with my own hand among the very authors on whose books I had heaped this harsh censure? I felt this inconsequence in all its force, I taxed myself with it, I blushed over it, but nothing could restore me to reason." Rousseau added that perhaps on the whole the composition of the New Heloïsa was turning his madness to the best account.

The ecstacies and transports of delirium that we have just witnessed were the conditions under which the New Heloïsa was begun, in the year 1757; it was finished in the winter of 1759–60. Rousseau was to suffer still further torments during the composition of this romance, but this time the visions were not mere impalpable shadows. The episode of his relations with Madame d'Houdetot was the cause of what Morley truly calls an outbreak of erotic mania. She visited his retreat disguised in male attire with results most disastrous to Rousseau's peace of mind. "A sort of palsy struck him. He lay weeping in his bed at night, and on days when he did not see the sorceress he wept in the woods. He talked to himself for hours, and was of a black humour to his housemates. When approaching the subject of this deadly fascination, his whole organization seemed to be dissolved. He walked in a dream that filled him with a sense of sickly torture, commixed with sicklier delight." Madame d'Houdetot remained faithful to her lover, Saint Lambert, but Rousseau's duplicity is well shown by a letter to Saint Lambert, after the affair had been noised abroad. "Is it possible that you can have suspected me of wronging you with her, and of turning perfidious in consequence of an unseasonably rigorous virtue? A passage in one of your letters shows a glimpse of some such suspicion. No, no, Saint Lambert, the breast of J. J. Rousseau never held the heart of a traitor, and I should despise myself more than you suppose, if I had even tried to rob you of her heart."

Both Saint Lambert and Madame d'Houdetot were exceedingly kind to Rousseau throughout the whole affair, which shows Rousseau in a

very bad light. It should not be forgotten, however, in drawing a balance between the good and evil in his character at this time that he was suffering tortures from a painful physical disorder. His brooding and egoistic character made it impossible for him to master his pain and rise superior to it. Rousseau had always been unsocial, but now he became bitter, irritable and suspicious. We are approaching the period of his quarrels with Grimm, Madame d'Epinay and Diderot, and it is but right that he should give his own account of his temperament at this time: "In my quality of solitary I am more sensitive than another; if I am wrong with a friend who lives in the world, he thinks of it for a moment, and then a thousand distractions make him forget it for the rest of the day; but there is nothing to distract me as to his wrong toward me; deprived of my sleep, I busy myself with him all night long; solitary in my walks, I busy myself with him from sunrise until sunset; my heart has not an instant's relief, and the harshness of a friend gives me in one day years of anguish. In my quality of invalid, I have a title to the considerateness that humanity owes to a man in agony. Who is the friend, who is the good man that ought not to dread to add affliction to an unfortunate wretch tormented with a painful and incurable agony?" Into the details of these quarrels it is not possible to enter here, nor to attempt to settle just how much Rousseau himself was to blame for the troubles that ensued. Grimm had disapproved of Madame d'Epinay's installing Rousseau in the Hermitage, and had warned her that solitude would darken his imagination,—"He is a poor devil who torments himself, and does not dare to confess the true subject of all his sufferings, which is in his cursed head and his pride; he raises up imaginary matters, so as to have the pleasure of complaining of the whole human race." He assures her several times that Rousseau would end by going mad, it being impossible that so hot and ill-organized a head should endure solitude.

The misunderstandings and quarrels reached such a pitch at last that Rousseau left the Hermitage on Dec. 15, 1757, and moved to a cottage at Montmorency. Ten days before this Diderot went to visit him. Rousseau cried out on seeing him, "What have you come here for?" "I want to know whether you are mad or malicious." "You have known me for fifteen years; you are well aware how little malicious I am, and I will prove to you that I am not mad: follow me." He then tried to clear himself, by means of letters, of the charge of trying to make a breach between Saint Lambert and Madame d'Houdetot, but the letters in fact convicted Rousseau of trying to persuade Madame d'Houdetot of the criminality of her relations with her lover, and at the same time to accept himself in the very same relation. Diderot remonstrated, but to no avail, and that night he wrote to Grimm, "I throw myself into your arms like one who has had a shock of fright; that man [Rousseau] intrudes into my work; he fills me with trouble, and I am as if I had a damned soul at my side. May I never see him again; he would make me believe in devils and hell."

Here closes another chapter of Rousseau's pathetic life, and we may let Morley sum up the story,—"And thus the unhappy man who had begun this episode of his life with confident ecstacy in the glories and clear music of spring, ended it looking out from a narrow chamber upon the sullen crimson of the wintry twilight and over fields silent in snow, with the haggard desperate gaze of a lost spirit."

The period that opened at Montmorency was the most productive one of his life. Within three years from the time of the moral maladies we have been witnessing, Rousseau "had completed not only the New Heloïsa, the monument of his fall, but the Social Contract, which was the most influential, and Emilius, which was perhaps the most elevated and spiritual, of all the productions of the prolific genius of France in

the eighteenth century." Rousseau completed the New Heloïsa in 1759, and published it in 1761; he published the Social Contract in the spring of 1762, and Emilius a few weeks later. For the last time in his life he was at peace with most of his fellows throughout this period. His new friends at Montmorency were the Duke and Duchess of Luxembourg, among the highest people in France, socially and politically.

We have seen the state of mental storm under which the New Heloïsa was begun, and now it was to be finished in this period of quiet and serenity. We might expect to find a great difference between the two halves of the romance, knowing how all important his surroundings were on all that Rousseau produced, and such in fact is the case. Morley thinks it curious that "while the first half of the romance is a scene of disorderly passion, the second is the glorification of the family," but it is hard to see what else was to be expected. The New Heloïsa "helped to give a new spirit to an epoch. . . . . The women between 1760 and the Revolution were intoxicated to such a pitch that they would pay any price for a glass out of which Rousseau had drank; they would kiss a scrap of paper that contained a scrap of his handwriting, and vow that no woman of true sensibility could hesitate to consecrate her life to him if she were only certain to be rewarded by his attachment. The booksellers were unable to meet the demand. The book was let out at the rate of twelve sous a volume, and could not be detained beyond an hour. All classes shared the excitement, courtiers, soldiers, lawyers and bourgeois. . . . . In Germany the effect was just as astonishing. Kant only once in his life failed to take his afternoon walk, and this unexampled omission was due to the witchery of the New Heloïsa." In numberless indirect ways it brought the manners of the great into contempt, by presenting the happiness of a simple and worthy life, simple, self-sufficing, and homely; but "his book and its chief personage awoke emotion to self-consciousness, gave it a dialect, communicated an impulse in favor of social order, and then very calamitously divorced it from the fundamental conditions of progress, by divorcing it from disciplined intelligence and scientific reason."

Although the New Heloïsa contained so much that was revolutionary, it did not involve the author in trouble with the authorities, but this was soon to follow. Emilius was completed, and the preparations were made for publishing it. These had to be carried on with much secrecy owing to the severe repressive measures to which the book trade was then subject. One day the printing came to a standstill, and Rousseau was unable to get any reason for this. "Being unable to discover either the cause or manner of it, I remained in the most cruel state of suspense. I wrote letter after letter to Guy, to M. de Malesherbes, and to Madam de Luxembourg, and not receiving answers, at least when I expected them, my head became so affected that I was not far from a delirium. I unfortunately heard that Father Griffet, a Jesuit, had spoken of Emilius, and repeated from it some passages. My imagination instantly unveiled to me the mystery of iniquity. I saw the whole progress of it as clearly as if it had been revealed to me. I figured to myself that the Jesuits, furious on account of the contemptuous manner in which I had spoken of colleges, were in possession of my work; that it was they who had delayed the publication; that, informed by Guerin of my situation, and foreseeing my approaching dissolution, of which I myself had no manner of doubt, they wished to delay the appearance of the work until after that event, with an intention to curtail and mutilate it, and in favor of their own views, to attribute to me sentiments not my own. The number of facts and circumstances which occurred to my mind, in confirmation of this silly proposition, and gave it an appearance of truth supported by evidence and demonstration, is astonishing. I knew Guerin to be entirely in the interest of the Jesuits.

I attributed to them all the friendly advances he had made me; I was persuaded he had, by their entreaties, pressed me to engage with Néaul, who had given them the first sheets of my work; that they had afterwards found means to stop the printing of it by Duchesne, and perhaps to get possession of the manuscript to make such alterations in it as they should think proper, that after my death they might publish it disguised in their own manner. . . . . After having been afraid of the Jesuits, I began to fear the Jansenists and philosophers. An enemy to party, faction and cabal, I never heard the least good of persons concerned in them. The gossips had quitted their old abode and taken up their residence by the side of me, so that in their chamber everything said in mine and upon the terrace, was distinctly heard, and from their garden it would have been easy to scale the low wall by which it was separated from my alcove. This had become my study; my table was covered with proof sheets of Emilius and the Social Contract, and stitching these sheets as they were sent to me, I had all my volumes a long time before they were published. My negligence and the confidence I had in M. Mathas, in whose garden I was shut up, frequently made me forget to lock the door at night, and in the morning I several times found it wide open; this, however, would not have given me the least inquietude had I not thought my papers seemed to be disarranged. After having several times made the same remark, I became more careful and locked the door. The lock was a bad one, and the key turned in it no more than half round. As I became more attentive, I found my papers in a much greater confusion than they were when I left everything open. At length I missed one of my volumes without knowing what was become of it until the morning of the third day."

There are those who date the first real outbreak of insanity from this time, and hold that Rousseau's suspicions of the Jesuits, then of the Jansenists and finally of the philosophers mark the foundation stones of the delusional system that he soon began to build. Möbius does not hold this opinion, but thinks that it is sufficient to say that Rousseau was physically sick, morbid, lonesome and irritable, and that indeed there were good grounds for his suspicions. However this may be, Rousseau's complaints at this time came perilously near the border line of systematized delusions, a border line that he was soon to cross. All this time he was suffering incessant pain, and passing his nights in sleeplessness and fever.

Emilius appeared at last, and with its appearance Rousseau became a persecuted wanderer, nevermore to enjoy peace or quiet. "On the 11th of June, 1762, the parliament of Paris ordered the book to be burnt by the public executioner, and the writer to be arrested. . . . The grounds of the proceedings were alleged irreligious tendencies to be found in the book." It was for the interest of Madame de Luxembourg and Malesherbes that Rousseau should escape arrest by flight, and he readily agreed to their plans. "After a tearful farewell with Theresa who had hardly been out of his sight for seventeen years, and many embraces from the greater ladies of the castle, he was thrust into a chaise, and despatched on the first stage of eight melancholy years of wandering and despair, to be driven from place to place," writes Morley, "first by the fatuous tyranny of magistrates and religious doctors, and then by the yet more cruel spectres of his own diseased imagination, until at length his whole soul became the home of weariness and torment."

Nothing could better illustrate Rousseau's introspective temperament and show how little hold the actual world had on him than that no sooner was he in the post-chaise than he again fell to musing over the tragic tale of the Levite of Ephraim, where his thoughts had been broken off by the circumstances that brought about his flight. Before the journey was ended he had composed a long and impassioned version of the Bible

story. He has himself characterized his own temperament in this respect: "It is amazing with what ease I forget past ill, however fresh it may be. In proportion as the anticipation of it alarms me and confuses me when I see it coming, so the memory of it returns feebly to my mind and dies out the moment after it has arrived. My cruel imagination, which torments itself incessantly in anticipating woes that are still unborn, makes a diversion for my memory, and hinders me from recalling those that have gone. I exhaust disaster beforehand. The more I have suffered in foreseeing it, the more easily do I forget it, while on the contrary, being incessantly busy with my past happiness, I recall it and brood and ruminate over it, so as to enjoy it over again when I wish."

Rousseau reached the territory of the canton of Berne, where he had remained but a few days before he received word that the Council at Geneva had ordered Emilius and the Social Contract to be publicly burnt. This blow was soon followed by another, for within a fortnight he received notice that he must quit the canton of Berne within fifteen days. He fled into territory that was under the King of Prussia, who gave him permission to remain.

Rousseau lived very plainly and simply, and spent much of the time in botanizing, and on all these excursions he always went bareheaded, even in dog-days, declaring that the action of the sun did him good. He spent three years in this quiet valley, and during this time he adopted the Armenian costume, the vest, furred bonnet, the caftan and the girdle. This adoption of an odd costume is often put in evidence for the unsettling of Rousseau's mind, but too much importance might easily be attached to this circumstance, and we must remember that his physical disorder made such a dress peculiarly appropriate for him. The Duke of Luxembourg and his wife did not think that vanity and a desire to attract attention had anything to do with the adoption of the costume.

He was not allowed to enjoy his retreat in peace, but was attacked by the clergy, beginning with the Archbishop of Paris, and then by the minister of Motiers, who had at first felt highly honored when Rousseau came to his communion. How great a part Rousseau played in the politics of the time is seen from the fact that his condemnation in 1762 by the Council of Geneva had divided the city into two parties, the point at issue being political rather than religious; for "to take Rousseau's side was to protest against the oligarchic authority which had condemned him, and the quarrel about Emilius was only an episode in the long war between the popular and aristocratic parties." Rousseau answered his persecutors in the Letters from the Mountain (1764), and an examination of these letters shows how unjust and illegal was the treatment Rousseau received from the authorities of his native city.

These letters involved him in fresh troubles, for the parliament of Paris ordered the Letters from the Mountain to be burned. But this was not the end. In 1765 a terrible libel on Rousseau appeared, full of the coarsest calumnies. He wrongly attributed it to a Genevese pastor, and refused to believe the pastor's disavowal. The clergy then attacked Rousseau, and he was warned not to present himself at the next communion. Rousseau would have been excommunicated but for the intervention of the King's officials; but the pastor stirred up his flock against him, and the people were told that Anti-Christ was among them. The Armenian apparel added to the plausibility of this notion. His botanizing was thought to be for noxious herbs, and he was accused of poisoning a man who had died. A block of stone was placed so as to kill him if he opened the door, and at length an attempt was made one night to stone him in his house. This was too much for his fortitude and he fled from the valley on Sept. 10, 1765, having been there three years.

He sought the Isle of St. Peter, in the Lake of Bienne, but unfortunately this was under the jurisdiction of the canton of Berne, and after he had been there but a short time he was ordered to quit the territory within fifteen days. In this dire extremity he made the following extraordinary request. He wrote to the representative of the authorities: "In this extremity I see only one resource for me, and however frightful it may appear, I will adopt it, not only without repugnance, but with eagerness, if their excellencies will be good enough to give their consent. It is that it should please them for me to pass the rest of my days in prison in one of their castles, or such other place in their States as they may think fit to select. I will there live at my own expense, and will give security never to put them to any cost. I submit to be without paper or pen, or any communication from without, except so far as may be absolutely necessary, and through the channel of those who shall have charge of me. Only let me have left, with the use of a few books, the liberty to walk occasionally in a garden, and I am content. Do not suppose that an expedient so violent in appearance is the fruit of despair. My mind is perfectly calm at this moment; I have taken time to think about it, and it is only after profound consideration that I have brought myself to this decision. Mark, I pray you, that if this seems an extraordinary resolution, my situation is still more so. The distracted life that I have been made to lead for several years without intermission would be terrible for a man in full health; judge what it must be for a miserable invalid worn down with weariness and misfortune, and who has no wish save only to die in a little peace."

He was not allowed even this poor privilege, and after considering in turn Vienna, Normandy, Lorraine, Potsdam, Holland, Corsica and Berlin, it was finally determined by his friends that he should go to England, and on Dec. 17, 1765, he found himself in Paris on his way to London.

Rousseau was accompanied to England by David Hume, to whom Lord Marischal had told the story of his persecutions four years previous, and Hume had offered to find a refuge for him in England. On January 13, 1766, they reached London, and Hume's charge excited much interest and had much attention shown him in London. Rousseau was anxious to leave the capital, and after several changes he was finally settled at Wootton, in Derbyshire, in a house belonging to a Mr. Davenport.

He was entirely ignorant of the language, and was without companionship except that of Theresa, in whose conduct, even while they were at Motiers, Rousseau had thought he perceived a growing coolness. After two months of solitude at Wootton, a fierce quarrel sprang up between Hume and Rousseau, one of the most famous of the quarrels of distinguished men. We have seen how the ground was gradually being prepared for an outbreak of mental disease, and this was now to come.

Hume was accused of being a member of an accursed triumvirate, of which Voltaire and D'Alembert were the other members. Their object was to blacken Rousseau's character and render his life miserable. Two letters that had appeared gave Rousseau great pain; one was the letter to Dr. Pansophe, and the other the letter of the King of Prussia to J. J. Rousseau. In the first, Rousseau is characterized as an idle hypocrite; in it Voltaire's pen was recognized by everyone. The letter from the King of Prussia appeared while Hume and Rousseau were in Paris. It is as follows: "My dear Jean Jacques: You have renounced Geneva, your native place. You have caused your expulsion from Switzerland, a country so extolled in your writings; France has issued a warrant against you, so do you come to me. I admire your talents; I am amused by your dreamings, though let me tell you they absorb you too

much and far too long. You must at length be sober and happy; you have caused enough talk about yourself by oddities which in truth are hardly becoming a really great man. Prove to your enemies that you can now and then have common sense. That will annoy them and do you no harm. My states offer you a peaceful retreat. I wish you well, and will treat you well if you will let me. But if you persist in refusing my help, do not reckon on my telling any one that you did so. If you are bent on tormenting your spirit to find new misfortunes, choose whatever you like best. I am a king and can procure them for you at your pleasure; and what will certainly never happen to you in respect of your enemies, I will cease to persecute you as soon as you cease to take pride in being persecuted. Your good friend, Frederick."

Rousseau at first suspected Voltaire of writing the letter, then D'Alembert; it was in reality written by Horace Walpole, to whom Rousseau had been introduced by Hume for the sake of entrusting some papers to Walpole to carry to England. Hume never told the world that the piece was a forgery, and he did not break with Walpole. It was horrible for Rousseau to think he had been deceived in Hume. He struggled against this view for a long time, but suspicion after suspicion developed, and finally the whole web became clear. He saw that he was the victim of a devilish plot. Repeated suggestions brought no answer from Hume, and Rousseau resolved to become explicit. On the 23d of June he wrote, "I know you, sir, and you know me. . . . Moved by your generosity I threw myself into your arms. You conducted me to England, apparently to furnish me with a refuge, but in reality in order to dishonor me. You devote yourself to this noble work with a zeal worthy of your noble heart, and a dexterity worthy of your powers."

At this attack Hume demanded explanations, and on July 10, 1766 Rousseau gave them in a long letter, the contents of which are somewhat as follows.

Rousseau realizes that he cannot furnish a judicial proof, his view depends entirely on his own conviction. He will openly and honorably relate the whole acquaintance, and call Hume's conscience to judgment, always speaking of Hume in the third person. He describes the beginning of their relations, their meeting together, their arrival in England, the brilliant reception in London, Hume's endeavors to procure him friends, and his other good acts. Hume had persuaded Rousseau to have his portrait painted, and taken pains to procure him a royal pension. Rousseau had declared that he would thankfully accept this pension, if Lord Keith would give his permission. Then followed the search for a residence and the settling at Wootton. "Then I thought that all my suffering had come to an end, but no, here it began to be more cruel than I had ever perceived." Rousseau narrates how since his arrival the tone of London has changed, how the journals follow him with scorn and sneers. "Since I am so accustomed to the fickleness of the public I do not wonder greatly at this abrupt change or over this singular unanimity, since not one of those who while absent made me so many promises has come forward and remembered me now that I am here. I found it odd that directly after the return of Mr. Hume, who enjoyed so great a reputation in London, who had so much influence with the authors and publishers, and who had such numerous associations, his presence should have had such entirely different consequences from what one would have expected from it, that not one of his friends should have showed himself to be one of mine. That those who spoke were not his enemies was clear since they praised his character." It had still further astonished him that in their personal intercourse his tone had become different. Hume's friends should have continually endeavored to show him attention, but the nature of their behaviour had changed.

Hume had made himself suspected through exaggerated flatteries, and had spoken insipid praises instead of the words of true friendship. In their intercourse Hume had given the impression that he did not wish so much to secure good will for Rousseau as assistance. Although Hume knew that Rousseau's pocket was not empty, yet more or less injurious offers were continually being made, as if Rousseau wished to live at the public cost. Yet let it be granted that this charity was offered with good intentions.

"Let us go still further. It is known that a false letter of the King of Prussia has appeared in Paris which is directed against me, and is full of the cruelest malice. I hear that this was written by a Mr. Walpole, a friend of yours. I ask if this is true, but instead of any answer Mr. Hume asks me from whom I know it. . . . . I understand that the son of that fool Tronchin, my deadliest enemy, is not only the friend and favorite of Mr. Hume, but even lives with him. Mr. Hume replies that this is true, but remarks that the son is not like the father. . . . . The letters that I write do not arrive; those that I receive have all been opened, and all pass through Mr. Hume's hands. If one escapes him he cannot conceal the burning desire to see it." Rousseau then cites an instance of Hume's desire to look over his letters. "After supper, as we were seated around the fire, I noticed that he looked at me fixedly, as was often the case with him, and in a way that is hard to describe. This time his dry, hot, mocking look made me more than restless. I tried to look at him in return, but as my eyes encountered his I felt an unaccountable shiver, and I soon had to cast mine down. The expression and the voice of the good David are those of a good man, but from where, good God, does this good man get the eyes with which he fixes his friends? The impression of that look remains and convulses me. My unrest increases to the point of consternation. . . . . Soon after I had some qualms of conscience, and in a moment of transport I threw my arms about his neck and closely embraced him, and called out with broken voice, 'No, no, David Hume is no traitor; were he not the best of men he would be the blackest of villains.' David returned my embrace heartily, and while he repeatedly patted my back, he kept saying, 'What, my dear sir! Oh! my dear sir! What is the trouble, my dear sir?' but said nothing beyond this. I felt as though my heart was cramped. Then we went to sleep, and on the morn I left for the provinces." He found no rest at Wootton. "Surrounded by the cruelest uncertainty, not knowing what I had to think of a man whom I loved so much, I tried to free myself from my horrible doubt, and to regain my trust in my benefactor. Why did he have externally so much zeal for my welfare while at heart he was planning my dishonor? Each individual fact was without such great importance, and it was only when taken together that they were so astonishing. Perhaps Mr. Hume could have given a satisfactory explanation. The great mystery was that he did not of himself offer the explanation which his honor and his friendship demanded."

At last Rousseau wrote a letter to Hume in which, on the one hand, he showed his gratitude, and, on the other, he could not conceal his disquiet. Hume in his answer had shown himself not at all disturbed; had written with cordiality of various things. "I was disturbed by this silence even more than I had been by his coolness in our last conversation. I was wrong; this silence after the other was very natural and I should have expected it, since if one dares to say to a man's face, 'I am tempted to consider you a villain,' and this man has not the curiosity to know why, then we must assume that he will not have such a curiosity during his whole life, and if the proofs do not in the least trouble him, then this man stands condemned." Rousseau now decides to break off his intercourse with Hume, and in this conclusion he became confirmed

when he learned from Theresa that Hume had inquired about his circumstances. This curiosity of Hume's in wishing to know Rousseau's every source of income had disturbed him before, and so this questioning behind his back was doubly against him. A new thrust was given by acquaintance with the letter of the King of Prussia, and this was now printed in French and English in the journals. "Instantly a light came to me as to the secret source of the astonishing and speedy revolution in public feeling, and I beheld in Paris the seat of the plot that came to a head in London." He thought D'Alembert to be the author of the letter, and remembered that Hume had been much prepossessed with D'Alembert. "The reading of this letter disturbed me greatly, since I knew that I had been made the object of a plot, the execution of which had just begun, and the limits of which were unknown to me. After I had been decoyed to England I felt the danger without knowing where it lay or how I could guard myself. Then occurred to me the four terrible words of Mr. Hume, of which I will soon speak." The letter, to his mind, was designed to take away people's interest in him, and even to excite anger against him. "But my sorrow, the deepest and bitterest grief that I suffered was not from the danger by which I was surrounded. I had endured too much of this to be particularly moved by it. The treachery of a false friend, whose booty I was, filled my all too sensitive heart with dejection and deadly sorrow. In the violence of my first agitation, which I could not control, and which my skillful enemies wished to bring on, I wrote a letter full of incoherence, in which I did not conceal either my uneasiness or my rebellion." Rousseau then calls attention to the fact that certain letters written in his favor, the printing of which Hume wished to oversee, had not appeared, as the letter of Dupeyron on the occurrences at Motiers. "When the false letter of the King of Prussia and its translation appeared, I understood why the other writings had been concealed." He allowed an explanation to be printed in the journals, in which he energetically characterized that false letter as a coarse fraud and gave expression to his bitter feelings. "Up to this time Mr. Hume appears to have proceeded in the dark. From now on you shall see him go forward in the light and without covering. When that false letter of the King of Prussia was published in London, Mr. Hume, who without doubt knew that it was forged, since I had told him so, neither said nor wrote anything. He kept silence and did not once think to give an explanation of the true state of the case for the benefit of his absent friend. . . . . Since Mr. Hume had brought me to England he was in a certain sense my protector. If it was natural that he should defend me, so it was not less natural that I should turn to him first for a published protest. I turned to some one else. The first blow on the cheek of my patron." In his explanation Rousseau had said that no matter who the author was, he had accomplices in England, and that this circumstance had broken his heart.

Still another libel appeared. Rousseau did not take much notice of it, and the public too had become tired of these things. Hume came back to the matter of the royal pension, obtained this for Rousseau, and informed him of the honor of the King. Rousseau was thrown into the greatest embarrassment; if he accepted it, he would thus be receiving a favor from an enemy, whom he looked on as his betrayer; if he declined it, he would hurt the feelings of the King and appear to be a fickle, imperious and thankless man. He chose the expedient of writing to Gen. Conway, and in a somewhat involved manner expressed his thankfulness as well as his inability to accept. "Mr. Hume has mediated in the affair, and has conducted it alone. I did not answer him at all, and in my letter I said no word of him. The third blow on the cheek of my patron; . . . . he felt nothing of it." This was the time

of the appearance of Voltaire's letter. While other acquaintances of Rousseau were mentioned in this, Hume's name was not mentioned at all. This surprised Rousseau and made him suspect that Hume had a share in the publication. Hume's friends were Rousseau's enemies, Tronchin, D'Alembert, Voltaire, and in London he had no other enemies except Hume's friends. "One discovers the web that has been spun in London since my arrival, and we shall see if it is not in Hume's hand that the threads are collected together. When finally the moment had come to strike the great blow, some one has prepared it by a new satirical composition." This piece convinced Rousseau fully and completely of Hume's faithlessness, since it showed designs that could only spring from him. It was said in it that Rousseau opened his doors to the great and shut them to the small; that Hume had guided Rousseau's entire course. Rousseau was cold towards his relatives; he had in Hume's presence coldly received a cousin. Rousseau was not only convinced that Hume had furnished the material for this composition, but also thought that Hume had done it with a view of letting Rousseau recognize his authorship, and thereby irritate him to anger. Hume struck the "great blow" by writing to Gen. Conway that the source of Rousseau's delay was the wish of the King that nothing be said about the pension, and as the General answered favorably, he sent a very friendly letter to Rousseau that he would receive the pension without that condition. "That was the deciding moment, the goal, the subject of all his endeavors. He wanted an answer. He wished it. Since I could not exempt myself from it he sent to Mr. Davenport an abstract of his letter, and not content with this precautionary measure, he wrote to me in another letter that he could no longer remain at my service in London. I almost fainted as I read this note." He now had the longed-for answer, and can triumphantly designate Rousseau as a monster of thanklessness. He had more, as he received from Rousseau an accusatory letter. "This stroke proves all and without contradiction." Rousseau once more goes through all the particulars cited by him, and comes to the conclusion that only a fool, and not such a sharp witted man as Hume could have deceived himself up to this time over Rousseau's apprehensions; that Hume, while he appeared unprejudiced and friendly, in spite of all his trustful signs in reality acted a part, since, while he continued showing kindness to Rousseau, he still pursued a hostile purpose. Hume must know that Rousseau did not esteem him, and that on this account he could receive no more favors from him. In spite of this he exerted himself in Rousseau's interest while pursuing a wicked plan. Hume said to himself: Now is the time for action, for, since I urge Rousseau to accept the pension, he must either accept it or send it back. If he accepts it, then I completely dishonor him with the proofs I have at hand. If he refuses it after he has formerly declared his willingness, and that pretext is withdrawn from him, then he must say why. That is what I wait for. If he accuses me he is lost. Only under the supposition of such a process of thought as this is Hume's course explicable to Rousseau. "The critical condition into which he had brought me reminds me of the four words I have mentioned before, and which I heard him speak and repeat at the time when I did not understand their significance at all. It was the first night of our journey from Paris. We were sleeping in the same room, and several times during the night I heard him call out in French with great vehemence, 'I have Jean Jacques Rousseau. I do not know whether he is awake or asleep.'" In spite of the fact that Rousseau interpreted the words at that time in a good sense, he was frightened at the tone in which they were spoken. "It was a tone of which I can give no idea and completely corresponded to the look which I mentioned earlier. Every time he spoke these words I felt a shudder that I could not master." He had forgotten the

occurrence and it came to his mind again for the first time in Wootton. "These words, whose tones resounded in my heart as if they had just been spoken, the long and terrible looks which he directed at me so often, the striking of the back with the words · 'My dear sir,' as an answer to the suspicion that he was a traitor, all frightened me in view of the other things, to such a degree that these remembrances will banish forever all trust from my heart. There was not a night in which the words, I have Jean Jacques Rousseau, did not sound in my ears as if I heard them anew. Yes, Mr. Hume, you have me, I know it. All the prejudices are in your favor. . . . . It costs you nothing to let me appear as a monster, in the way you have already begun, and I already hear the barbaric rejoicings of my enemies," The public also is for Hume, since he can point to the services he has rendered Rousseau, and all will praise the one who has rendered the services, since they themselves would like to receive such. Intelligent people will indeed judge otherwise, but in this it matters little, and they are not of those who make a noise. Rousseau can only reckon on the consolation of his conscience. He will have the scorn of men, and to the end, in misfortune as well as in fortune, he will do that which he thinks honorable and right. "My body is weakened, but never was my soul stronger." He wonders that he has found the strength for this letter. "If one could die from grief I should have died at every line of this." Finally, he still leaves room for doubt. He sees a gulf on both sides. He is the unluckiest of men if Hume is guilty; he is the most contemptible if he is innocent. Still he will prefer the latter case. "If you are guilty, do not write me. . . . . If you are innocent, think it worth while to vindicate yourself. I recognize my duty. I love you and will continue to love you, hard as it may be. Once more, consider it worth while to justify yourself; if you are guilty, adieu forever."

The preceding extract quoted by Möbius from this long letter is necessary to give an idea of Rousseau's mental condition at this time, for here, beyond any doubt are the first marked signs of paranoia, the first indubitable evidence of insanity. It is not possible here to enter into a discussion of these charges against Hume. Without doubt Rousseau had some reason to be dissatisfied with Hume's coldness and failure to appreciate his feelings, but throughout the acquaintance Hume had shown himself to be a true friend to Rousseau and never to have had in mind anything but his good.

As not infrequently happens in delusions of persecution, there was a basis of fact for Rousseau's accusations, for Hume might have set matters right to some extent by publishing his knowledge of the falsity of the letter of the King of Prussia, yet the manner in which all the circumstances are twisted and perverted by Rousseau, and Hume's most innocent acts misinterpreted, and the complete web of a delusional system of persecution formed, all show the formal systematization of the delusions of a paranoiac. It was not in his condemnation of Hume that his morbidness lay, but in the fact that he saw in Hume's behavior and in almost everything that befel him in England the results of a deep laid plan, and recognized everywhere the conspiracy to injure him. Many of the circumstances are so easy to explain that Rousseau could not have misunderstood them without a morbid blindness. It is scarcely possible that even in Paris Rousseau should not have known how closely allied Hume was to all the literary celebrities, and also to his own enemies, Voltaire, D'Alembert, and others. Instead of wondering at the attacks which he suffered in London, Rousseau, to whom the methods of thought and influence of Voltaire were well known, should have recognized in the forged letter the natural reaction against his brilliant reception in London. It is not to be doubted at all that

Voltaire's envy and hatred were excited by the honor that had been shown Rousseau.

Möbius, from whom we have just been quoting, thinks it could scarcely have escaped Rousseau that his relations to his housekeeper gave offense to English society, and that on this account many people showed a different aspect after Theresa's arrival.

Möbius rightly assumes that the insane character of Rousseau's letter will be evident even to the laity, as well as the delusional character of the inferences and deductions with regard to the pension; of especial importance is the scene by the fireside, and Hume's calling out at night. To attach such secret importance to the looks and voice of suspected persons that these call forth an unaccountable shudder is the very essence of paranoia.

We shall see from now on, says Möbius, how in Rousseau's life there soon comes an ebb and flow of excitement, alternating with quiet. The strong excitement in Hume's case is the first wave. The storm lulled again, but what had arisen in him remained ever afterward the chief fact of his existence; the idea of a plot, as great as it was secret, of which he was the victim, was never absent from his mind. He remained convinced, also, that his judgment and treatment of Hume were completely right.

In commenting on Rousseau's condition at this time Möbius remarks that hallucinations appear never to have been present, and that his insanity consisted throughout in a false interpretation of actual occurences. On the other hand Rousseau's undoubted veracity is made evident by innumerable proofs, and there is no reason to doubt his actual statements. Indeed it is often hard to say where observation ceases and conclusions from the observation begin.

The quarrel with Hume was a great blow to Rousseau. Hume's "concise rejoinder" appeared, and Rousseau's "boundless pride," "unthankfulness," and "hypocrisy," became matters of common report. The French edition of the rejoinder appeared with a preface glorifying Hume, and it afterwards appeared that D'Alembert had assisted in this. The great mathematician wrote later, "Jean Jacques is a wild beast that one dares to touch only behind iron bars, and with a stick."

In newspapers, pamphlets and letters, the hostility raged against Rousseau. He allowed the storm to roar away, sighed and kept silence. More and more he saw the number of his friends diminish. If the two ladies, Boufflers and Verdelin, had before this been objects of suspicion to him, since thy had brought about his connection with Hume, he now completely lost trust in them as they wrote him reproachful letters. And now, also, the one man whom he had cherished in the highest degree, and whom he had never before doubted, Lord Keith, appeared to turn away from him. One reads with painful emotion Rousseau's letter, in which with expressions of tender regard he implored his friend to give him some sign, but in vain; the marshal remained mute, and Rousseau had to give him up.

Deeply as these experiences wounded Rousseau, feeling as he did that he was destined to be "henceforth disgraced in the eyes of men, and to stand forth degraded," yet his elastic nature quickly recovered itself as the excitement died out. All his thoughts turned toward quiet; he wished to be forgotten by the world, and so far as he could, to forget it. Botany, which had before served him in time of trouble, again became his diversion. He would read only botanical books, and would speak only of plants with his friends.

In fair weather Rousseau was scarcely ever in the house, but in poor weather, and in the cold season of the year he busied himself, in addition to reading botanical books, in writing the memoirs of his youth. The plan of writing his life had been conceived at Montmorency, and

with this object in mind he had examined and arranged his letters in Motiers, and as the papers were fortunately in England he began to write down his "Confessions." It cannot be doubted that from the beginning Rousseau had the idea of doing this in the way he actually did it. The attacks that had been made on his personal character, especially the abuse of the "*Sentiment des Citoyens*," had given him the idea of answering his enemies in this way, by showing himself in complete truth to nature, unveiled in evil as well as in good, so that if any one accused him of other badness he would be able to call such statements untruths.

As his introduction to the "Confessions" throws much light on his mind at this time, it may properly find a place here.

"I have entered on a performance that is without example, whose accomplishment will have no imitator. I mean to present my fellow-mortals with a man in all the integrity of nature; and this man shall be myself.

"I know my heart and have studied mankind; I am not made like any one I have been acquainted with, perhaps like no one in existence; if not better, I at least claim originality, and whether nature did wisely in breaking the mould with which she formed me, can only be determined after having read this work.

"Whenever the last trumpet shall sound, I will present myself before the Sovereign Judge with this book in my hand and loudly proclaim, thus have I acted; these were my thoughts; such was I. With equal freedom and veracity have I related what was laudable or wicked, I have concealed no crimes, added no virtues; and if I have sometimes introduced superfluous ornament, it was merely to occupy a void occasioned by defect of memory: I may have supposed that certain, which I only knew to be probable, but have never asserted as truth a conscious falsehood. Such as I was, I have declared myself; sometimes vile and despicable, at others virtuous, generous and sublime; even as Thou hast read my immortal soul, Power Eternal! Assemble round Thy throne an innumerable throng of my fellow-mortals, let them listen to my confessions, let them blush at my depravity, let them tremble at my sufferings, let each in his turn expose with equal sincerity the failings, the wanderings of his heart, and, if he dare, aver, *I was better than that man.*"

Of this introduction Morley says: "The exaltation of the opening page of the Confessions is shocking. No monk nor saint ever wrote anything more revolting in its blasphemous self-feeling. But the exaltation almost instantly became calm, when the course of the story necessarily drew the writer into objective facts, even muffled as they were by memory and imagination. The brooding over old reminiscence soothed him, the labor of composition occupied him, and he forgot, as the modern reader would never know from internal evidence, that he was preparing a vindication of his life and character against the infamies with which Hume and others were supposed to be industriously blackening them."

The condition of quiet which Rousseau enjoyed in his botany and in writing his "Confessions" continued until the spring of 1767. During the winter a misunderstanding had arisen between him and his host, Mr. Davenport, although but little is known with regard to the circumstances. At this time there were quarrels between Theresa and the servants, and this added to Rousseau's annoyance, and his agitation began to increase. He thought that his correspondence was everywhere watched, that he was everywhere surrounded by spies, and that his enemies were upon the point of taking possession of the manuscript of his "Confessions." He writes to Dupeyron: "On all sides I am in the snare, and am unable to bring myself out of it. In the hands of everyone, I can carry out no plan for freeing myself. Oh, miserable fate!

Oh, my friend, pray for me! It seems to me that I have not deserved the sufferings that bear me down."

To free him from the care of his papers Dupeyron asked an acquaintance to go to Wootton and take the writings in charge. Still Rousseau was not quieted. He had reached the conclusion that the people who brought and opened his letters, the postal authorities, and in short the whole world, were in the service of his enemies, and that it was designed to break off all intercourse with him and thereby to rob him not only of assistance, but even of sustenance.

Further residence at Wootton now became unbearable, and on the first of May he suddenly ran away with Theresa, leaving money, papers, and all else behind. After a fortnight Mr. Davenport received a letter from him dated at Spalding, in Lincolnshire.

Mr. Davenport sent a servant to Spalding to accompany Rousseau back, but before he reached there the poor creature had again disappeared. To the village parson he had appeared cheerful and good humored, and they had spent several hours in company each day. While in Spalding he wrote a long letter to the Lord Chancellor praying that he would appoint a guard at Rousseau's own expense to escort him in safety out of the kingdom where enemies were plotting his life. At Dover, where he was next heard of, he wrote a letter to Gen. Conway setting forth his delusion in full form. He is the victim of a plot; the conspirators will not allow him to leave the island, lest he should divulge in other countries the outrages to which he has been subjected here; he perceives the sinister manœuvres that will arrest him if he attempts to put his foot on board ship. But he warns them that his tragical disappearance cannot take place without creating inquiry. Still if Gen. Conway will only let him go he gives his word of honor that he will not publish a line of the memoirs he has written nor ever divulge the wrongs he has suffered in England. "I see my last hour approaching," he concluded; "I am determined if necessary to advance to meet it, and to perish or be free; there is no longer any other alternative." On the same evening that he wrote this letter he took boat and landed at Calais, where he seems at once to have recovered his composure.

We have followed Rousseau's career up to this point with considerable minuteness, and have attempted to show how one event logically followed another; how from birth he was the slave of his temperament, always yielding to the pleasant and agreeable, never choosing the harder part if it were to result in a loss of sensuous enjoyment. To the psychologist no historical character is more worthy of study; to the alienist the story of his life affords an unmatched clinical history of the evolution of systematized delusions of persecution. It is not possible here to follow in detail the further particulars of his mental disease, and the remaining events must be passed over rapidly.

After landing at Calais he was secretly conveyed by the Marquis of Mirabeau to Fleury, but remained here only a few weeks. Then he was installed by the Prince of Conti at Tyre, one of his country seats, where he went by the name of Renou.

Of the remaining years of his life we may let Morley speak, for he tells in striking language of the clouded life of a person suffering with chronic delusional insanity.

"Rousseau remained for a year at Tyre (June, 1767—June, 1768), composing the second part of the "Confessions," in a condition of extreme mental confusion. Dusky phantoms walked with him once more. He knew the gardener, the servants, the neighbors, all to be in the pay of Hume, and that he was watched day and night with a view to his destruction. He entirely gave up either reading or writing, save a very small number of letters, and he declared that to take up the pen

even for these was like lifting a load of iron. The only interest he had was botany, and for this his passion became daily more intense. He appears to have been as contented as a child, so long as he could employ himself in long expeditions in search of new plants, in arranging a herbarium, in watching the germ of some rare seed which needed careful tending. But the story had once more the same conclusion. He fled from Tyre as he had fled from Wootton. He meant apparently to go to Chambéri, drawn by the deep magnetic force of old memories that seemed long extinct. But at Grenoble, on his way thither he encountered a substantial grievance. A man alleged that he had lent Rousseau a few francs seven years previously. He was undoubtedly mistaken, and was fully convicted of his mistake by the proper authorities, but Rousseau's correspondents suffered none the less for that. We all know when monomania seizes a man, how adroitly and how eagerly it colors every incident. The mistaken claim was proof demonstrative of that frightful and tenebrous conspiracy, which they might have thought a delusion hitherto, but which, alas, this showed to be only too tragically real; and so on, through many pages of droning wretchedness. Then we find him at Bourgoin, where he spent some months in shabby taverns, and then many months more at Monquin on adjoining uplands. The estrangement from Theresa, of which enough has been said already, was added to his other torments. He resolved, as so many of the self-tortured have done since, to go in search of happiness to the western lands beyond the Atlantic, where the elixir of bliss is thought by the wearied among us to be inexhaustible and assured. Almost in the same page he turns his face eastward, and dreams of ending his days peacefully among the islands of the Grecian archipelago. Next he gravely, not only designed, but actually took measures, to return to Wootton. All was no more than the momentary incoherent purpose of a sick man's dream, the weary distraction of one who had deliberately devoted himself to isolation from his fellows, without first sitting down carefully to count the cost, or to measure the inner resources which he possessed to meet the deadly strain that isolation puts on every one of a man's mental fibres. Geographical loneliness is to some a condition of their fullest strength, but most of the few who dare to make a moral solitude for themselves, find that they have assuredly not made peace. Such solitude, as South said of the study of the Apocalypse, either finds a man mad or leaves him so. Not all can play the stoic who will, and it is still more certain that one who like Rousseau has lain down with the doctrine that in all things imaginable it is impossible for him to do at all what he cannot do with pleasure, will end in a condition of profound and hopeless impotence in respect to pleasure itself.

"In July, 1770, he made his way to Paris, and here he remained eight years longer, not without the introduction of a certain degree of order into his outer life, though the clouds of vague suspicion and distrust, half bitter, half mournful, hung heavily as ever upon his mind. The Dialogues, which he wrote at this time to vindicate his memory from the defamation that was to be launched in a dark torrent upon the world at the moment of his death, could not possibly have been written by a man in his right mind. Yet the best of the Musings, which were written still nearer the end, are masterpieces in the style of contemplative prose. The third, the fifth, the seventh, especially abound in that even, full, mellow gravity of tone which is so rare in literature, because the deep absorption of spirit which is its source is so rare in life. They reveal Rousseau to us with a truth beyond that attained in any of his other pieces—a mournful sombre figure, looming shadowily in the dark glow of sundown among sad and desolate places. There is nothing like them in the French tongue, which is the speech of the clear, the cheerful, or the august among men; nothing like this sonorous plainsong,

the strangely melodious expression in the music of prose of a darkened spirit which yet had imaginative visions of beatitude. . . . . Rousseau seems to have repulsed nearly all his ancient friends, and to have settled down with dogged resolve to his old trade of copying music. In summer he rose at five, copied music until half-past seven; munched his breakfast, arranging on paper during the process such plants as he had gathered the previous afternoon; then he returned to his work, dined at half-past twelve, and went forth to take coffee at some public place. He would not return from his walk until night-fall, and he retired at half-past ten. The pavements of Paris were hateful to him because they tore his feet, and, said he, with deeply significant antithesis, 'I am not afraid of death, but I dread pain.' He always found his way as fast as possible to one of the suburbs, and one of his greatest delights was to watch Mont Valérin at sunset. 'Atheists,' he said calumniously, 'do not love the country; they like the environs of Paris, where you have all the pleasures of the city, good cheer, books, pretty women; but if you take these things away, then they die of weariness.' The note of every bird held him attentive, and filled his mind with delicious images. A graceful story is told of two swallows who made a nest in Rousseau's sleeping-room, and hatched the eggs there. 'I was no more than a doorkeeper for them,' he said, 'for I kept opening the window for them every moment. They used to fly with a great stir round my head, until I fulfilled the duties of the tacit convention between these swallows and me.'"

In 1772 he became acquainted with Bernardin de St. Pierre, author of the immortal *Paul and Virginia*, and for a time their friendship was warm and cordial. St. Pierre has given some graceful pictures of Rousseau's life at this time. Of Rousseau himself he says: "He was thin and of middle height; one shoulder struck me as higher than the other . . otherwise he was very well proportioned. He had a brown complexion, some color on his cheek-bones, a good mouth, a well-made nose, a rounded and lofty brow, and eyes full of fire. The oblique lines falling from the nostrils to the extremity of the lips, and marking a physiognomy, in his case expressed great sensibility and something even painful. One observed in his case three or four of the characteristics of melancholy—the deep receding eyes and the elevation of the eyebrows: you saw profound sadness in the wrinkles of the brow; a keen and even caustic gaiety in a thousand little creases at the corners of the eyes, of which the orbits entirely disappeared when he laughed."

All went smoothly for a time between the two friends, but finally St. Pierre shared the fate of his predecessors. Once more we will let Morley tell the story, and this time to the end. "Things did not continue to go thus smoothly. One day St. Pierre went to see him, and was received without a word, and with stiff and gloomy mien. He tried to talk but only got monosyllables; he took up a book, and this drew a sarcasm which sent him forth from the room. For more than two months they did not meet. At length they had an accidental encounter at a street corner. Rousseau accosted St. Pierre, and with a gradually warming sensibility proceeded thus: 'There are days when I want to be alone, and crave privacy. I come back from my solitary expeditions so calm and contented. There I have not been wanting to anybody, nor has anybody been wanting to me,' and so on. He expressed this humour more pointedly on some other occasion, when he said that there were times in which he fled from the eyes of men as from Parthian arrows. As one said who knew from experience, the fate of his most intimate friend depended on a word or a gesture. Another of them declared that he knew Rousseau's style of discarding a friend by letter so thoroughly that he could supply Rousseau's place in illness or absence. . . . . With Gluck he seems to have quarrelled for setting his music to French

words, when he must have known that Italian was the only tongue fit for music. Yet it was remarked that no one ever heard him speak ill of others. His enemies, the figures of his delusion, were vaguely denounced in many dronings, but they remained in dark shadows and were unnamed. When Voltaire paid his famous last visit to the capital (1778), some one thought of paying court to Rousseau by making a mock of the triumphal reception of the old warrior, but Rousseau harshly checked the detractor. . . . . He was extremely poor these last eight years of his life. He seems to have drawn the pension which George III had settled on him, for not more than one year. We do not know why he refused to receive it afterwards. A well-meaning friend, when the arrears amounted to between six and seven thousand francs, applied for it on his behalf, and a draft for the money was sent. Rousseau gave the offender a vigorous rebuke for meddling in affairs that did not concern him, and the draft was destroyed. Other attempts to induce him to draw this money failed equally. Yet he had only about fifty pounds a year to live on, together with the modest amount he earned by copying music.

"The sting of indigence began to make itself felt towards 1777. His health became worse, and he could not work. Theresa was waxing old and could no longer attend to the small cares of the household. More than one person offered them shelter and provision, and the old distractions as to a home in which to end his days began once again. At length M. Girardin prevailed upon him to come and live at Ermenonville, one of his estates about twenty miles from Paris. A dense cloud of obscure misery hangs over the last months of this forlorn existence. No tragedy had ever a fifth act so squalid. Theresa's character seems to have developed into something truly bestial. Rousseau's terrors of the designs of his enemies returned with great violence. He thought he was imprisoned, and he knew that he had no means of escape. One day (July 2, 1778), suddenly, and without a single warning symptom, all drew to an end; the sensations which had been the ruling part of his life were affected by pleasure and pain no more, the dusky phantoms all vanished into space. The surgeons reported that the cause of his death was apoplexy, but a suspicion has haunted the world ever since that he destroyed himself by a pistol shot. We cannot tell. There is no inherent improbability in the fact of his having committed suicide. In the New Heloïsa he had thrown the conditions which justified self-destruction into a distinct formula. Fifteen years before he had declared that his own case fell within the conditions which he had described, and that he was meditating action. Only seven years before he had implied that a man had the right to deliver himself of the burden of his own life, if its miseries were intolerable and irremediable. This, however, counts for nothing in the absence of some kind of positive evidence, and of that there is just enough to leave the manner of his end a little doubtful. Once more, we cannot tell.

"By the serene moonrise of a summer night, his body was put under ground on an island in the midst of a small lake, where poplars throw shadows over the still water, silently figuring the destiny of mortals. Here it remained for sixteen years. Then amid the roar of cannon, the crash of trumpet and drum, and the wild acclamations of a populace gone mad in exultation, terror, fury, it was ordered that the poor dust should be transported to the national temple of great men."

V.—MISCELLANEOUS.

Erster Nachtrag zur Bibliographie des modernen Hypnotismus. MAX DESSOIR. Berlin, 1890. pp. 44.

The excellent bibliography published by this author in 1888 here re-

ceives a supplement carrying the literature up to May, 1890. This record of two years work contains no fewer than 382 references,—certainly an enormous, not to say an alarming increase. The plan of arrangement is precisely the same as that followed in the original bibliography. France still leads in the number of contributions, but Germany is not far behind. Thirteen languages and 113 periodicals (47 of them new ones) are represented in the bibliography. The author certainly deserves gratitude and credit for the able execution of a rather unpleasant task. J. J.

Laura Bridgman; Erziehung einer Taubstumm-Blinden. Prof. W. JERUSALEM. Wien, 1890. pp. 76.

There has not, it appears, been any adequate account of Laura Bridgman in German till the publication of this study. On the basis of Dr. Howe's reports and all the important publications concerning his pupil and his method of educating her, Prof. Jerusalem reviews her early life, her education, her sense perceptions, speech, thought, feelings and dreams, and also adds matter relating to other similar cases. Though we have now at length a reprint of Dr. Howe's Reports, besides Mrs. Lamson's book and other less important literature accessible in English, Prof. Jerusalem's pamphlet probably furnishes the matter of immediate interest to psychology and pedagogy in the most convenient compass.

Epitomes of Three Sciences. The Open Court Publishing Company, 169 LaSalle street, Chicago, 1890. pp. 139.

This little volume gives a bird's-eye view of the present state of things in Comparative Philology, Scientific Psychology, and Old Testament History. The authors are Prof. H. Oldenberg of Kiel, Prof. Joseph Jastrow of the University of Wisconsin, and Prof. C. H. Cornill of Königsberg. The epitomes, (which have previously appeared in the *Open Court* and part of them also in German publications), were written from the scientific standpoint. They are here gathered for the contribution that they may make to questions of philosophy and religion, perhaps especially to the detheologized kind which the *Open Court* represents. The epitome of Scientific Psychology, though made by a writer uncommonly well equipped for such work, sufferes from the vast variety of matter to be epitomized.

The Monist. Vol. I, No. 1, October, 1890. A quarterly magazine published by the Open Court Publishing Company, Chicago. Yearly subscription $2.00, single numbers fifty cents.

The monistic tendency of modern philosophical, religious, and scientific thought has an able representative in this new quarterly. The journal's standpoint is expressed in the following sentence from its announcement. "The thinkers of mankind, whatever may be their philosophical or religious views, are working, every one in his own province, at one and the same great problem, which is a unitary conception of the world, free from contradictions and based upon the facts of life." Its aim is to present "the best, the maturest, and the most progressive work of human thought at present carried on in both hemispheres." The table of contents of the first number shows an array of distinguished names—Romanes, Binet, Cope, Mach, Carus, Dessoir, Salter. In addition to contributions by the writers mentioned, the number contains literary correspondence from France by Lucien Arreat, an account of the instruction in philosophy in a number of leading American Universities, and critical reviews of philosophical literature. One or two of the articles are practically restatements of matter already once published, but in each case the matter is of sufficient value to be

well worthy of republication. Judging from this first number *The Monist* bids fair to be a valuable instrument in the spread of philosophic and scientific thought. W. H. B.

The Ethics of Evolution J. H. HYSLOP. New Englander and Yale Review. Sept. 1890.

The evolution of which Prof. Hyslop speaks is that of the animal series, with its struggle for existence and survival of the fittest; its ethical principle is the right of the strongest. That such an ethical ideal would shiver civilization, if once it should be practiced, can readily be admitted; and by citations of early and later opinions of Huxley, Spencer, Darwin and Carlyle the author endeavors to show the power of this ideal to force itself upon the minds of those that have to do with it—that "nature is a Medusa head on which no moralist can look and live." The theory of evolution then furnishes no principle of ethics which can for a moment be accepted; "the whole of man's moral achievements have been effected *by putting limits to the struggle for existence*;" his moral ideals must come from elsewhere. Much that is here said of animal evolution is by no means true of that broader theory which would make the heroic revolt against nature spoken of by the author itself a product of evolution; but this he seems to complain would rob the theory of its force as a controversial weapon.

Philosophy in Homeopathy. C. S. MACK, M. D. Gross and Delbridge, Chicago, 1890. pp. 174.

In the several addresses, etc., which make up this little book are developed with some repetition the author's idea of the rationale of homeopathy. There are facts, he believes, beyond inductive science which are endorsed and substantiated by the reason of man, and from which he may proceed deductively in the development of the art of medicine. Such a principle is the homeopathic *similia similibus curantur*. By a process of logical exclusion he shows that there are no other methods of cure than that so stated. By "cure," however, he means not the recovery of the patient, which may take place of itself when the exciting cause of his trouble is removed (a method of treatment often justifiable), but the production of such a change in the vital processes as shall set them right. When he would explain how "*similia*," as he calls it, secures this change, it is a mystic and Swedenborgian explanation that he furnishes. The author's spirit is non-polemical, but we must tell him that his method of deduction from principles other than those inductively established has been the mother of numberless follies in medicine already, and that the less of such philosophy in homeopathy the better for it.

Ueber die Methoden der Messung des Bewusstseinsumfanges. W. WUNDT. Philos. Studien, Bd. VI, H. 2, S. 250; 1890.

In this short paper Prof. Wundt discusses the methods of measuring the *Umfang* or extent of consciousness and replies to the criticisms of Schumann on his method (see review of Schumann's paper in this JOURNAL, Vol. III, p. 290). The question of the extent of consciousness in this sense is not very different from that of how many simple ideas can be present in the mind at one time. Prof. Wundt's method, as applied by his pupil Dietze, was in principle this: a series of regularly timed sounds are produced; as each member of the series is given, it rises in the focus of consciousness, and then giving place to the next, it advances by degrees toward the limit of consciousness, which it finally passes. If by any means it is possible then to find the number of sounds in a series of which the first is just on the point of disappear-

ing when the last is just in the focus of consciousness, that number would be a measure of the extent of consciousness. In Wundt's method that number is found by finding the longest series that can be accurately compared with a slightly longer or shorter series (of course without counting), on the hypothesis that two series cannot be compared accurately when they are so long as to extend beyond the bounds of consciousness. The essence of Schumann's criticism, if we understand him, is that each sound as it comes is commonly responded to by some sort of a muscular contraction, and that after a few repetitions of the first or standard series the *number* of muscular contractions becomes established, unconsciously of course, and that same number is repeated when the second or comparison series is given. If the muscular contractions cease before the second series is ended the series is judged to be longer; if they over-run, the series is judged to be shorter. [For brevity we may call this adjustment of the muscular responses an unconscious counting of them.] A comparison of the number of sounds in two series, made in this way would be as useless for determining the extent of consciousness, as one made by conscious counting; what would really be measured would be how many sounds a man can count unconsciously. To this Prof. Wundt replies that he observes a clear difference in the process of comparison between series that can be compared as wholes and those that cannot be so compared. The line of demarkation between series that can be compared with some certainty, and those where the comparison is made uncertain by increasing length, is sharply drawn; as it should be if there is a change such as Prof. Wundt observes in the method of comparison. To the reviewer's mind however, he fails to answer satisfactorily Schumann's main point namely that the series are compared by means of what is little less than unconscious counting. E. C. S.

NOTES.

It is announced by the *Revue Philosophique*, Oct. 1890, that a Laboratory for Physiological Psychology under the direction of Sergi is to be opened at the University of Rome.

In the *Vierteljahrssch. f. wiss. Philos.*, XIV., (1890), 1, M. Radakovic makes a careful study of the fundamental assumptions of Fechner's logarithmic formulæ for the relation of intensity of stimulus to intensity of sensation, and endeavors to re-deduce it in a way less open to criticism.

G. Itelson, in an article entitled Zur Geschichte des psycho-physischen Problems, *Arch. f. Gesch. d. Philos.*, III, 1890, 282, concludes from the negative assertions of past philosophers that there is need of a critical determination of whether or not sensations are measurable. In reviewing his article in the *Zeitsch. f. Psych.*, I, 128, Prof. Ebbinghaus reminds him that Comte's assertion in 1834 that the chemistry of the stars would never be known, was by 1860 a wholly antiquated and unfruitful speculation.

On the new façade of the cathedral at Florence is a white marble balustrade through the decorative openings in which one can look eastward against the blue sky. When one looks at these openings in the afternoon, with the sunlight on the surrounding marble and the sky a deep blue, they appear, says Prompt (*Archives de physiol.*, 1890, No. I, p. 59), not as openings but as if filled with a blue mosaic; there is no separation of the sky from the balustrade. When one looks in the morning, with the eastern sky bright and pale and the surrounding marble in shadow, there is no such illusion. This observation falls in with the author's theory that by such differences in light and shade we perceive the relief of distant objects; we habitually locate dark figures on light ground in that ground, but light figures on dark ground apart from it.

In opposition to the theory that the lack of muscular co-ordination in ataxy is due to the lack of normal sensations from the joints, tendons, etc., of the limbs affected, Rumpf urges (*Deutsch. Arch. f. klin. Med.*, XLVI, p. 35) that cases of severe sensory disturbance are not always attended by ataxy. A normal person, writing with closed eyes, writes as usual; a patient with reduced sensibility in his hand and arm writes larger under those circumstances; an ataxic patient shows his inco-ordination. The first, he explains, simply shifts from ocular control to control by the sensations from the writing member; the second has to make greater movements to get recognizable sensations, but need show no ataxy.

The editors of the new *Zeitschrift für Psychologie* are most fortunate in being able to secure for their review department abstracts of important papers by the writers of them. In the second number, Oehrwall, of Upsala, gives the outline of his researches on the sense of taste (see note below epitomizing this abstract), and Goldscheider resumés two of his papers on muscle-sense, some of the points of which have already been noticed in this JOURNAL. In the third number Preyer treats similarly of the new edition of his *Die Seele des Kindes*, Gaule of his counting

of the fibres in the spinal cord of the frog, and Kronthal of his note in the *Neurolog. Centralbl.* on the large cells of the anterior horns. Other things being equal, no one is so well able to present the salient points of his paper as the author of it. In this day of multiplied and elaborate research there is much propriety in an author's thus furnishing for hurried workers in other departments an authoritative statement of his results.

A magnificent experiment in the psychology of courage will be tried when the new long range guns and smokeless powder are first brought into actual use on the battle-field. The problem was thus stated by a writer in the New York *Evening Post*, some time since: "Will the soldiers' morale stand the comparatively normal atmosphere of future battle-fields? Without forcing the note, as some writers do who speak of a verdant country where no noise is heard, where nothing stirs, but out of which death is belched through invisible cannon and guns (simple physical laws are opposed to this uncanny conception of a silence so deep and invisibility so complete), it must be granted that with shooting at long range there will be perplexity in the apparent emptiness of the field. This uncertainty will have limits; but to what extent the soldier's nerves will be tried when, the stimulating excitement of smoke and noise failing, he will be more keenly alive to the horrors of the battle, is a question that without actual experience no knowledge of humanity can answer."

After canvassing former analyses of the sensations of taste, Oehrwall (*Skandinav. Archiv f. Physiol.* Bd. II. (1890) S. 1–69) ranges himself with those that find only four tastes, to wit: bitter, sweet, salt, sour. Between these there are no transitions; nor can a mixture of them, like a mixture of colored lights, give rise to a new inseparable sensation; nor are there contrast or compensation phenomena to be found among them. These four are as distinctly different senses as those of heat, cold, and pressure, the independence of which is becoming generally recognized. This view is supported by the facts that the same substance may excite different taste sensations, as it is applied to the tip or back of the tongue; and that the reaction-time for bitter at the tip of the tongue is longer than for the other three. The electrical taste, which has given trouble to the physiologists, is explained as due to stimulation of special end organs in the tongue and not, as Hermann contended, to action upon the nerve fibres and their sheaths. Cocain applied to the tongue abolished both normal and electrical taste sensations, but not those of temperature. The major part of the paper is devoted to Oehrwall's own experiments. After the manner of Blix and others, in studying the hot and cold spots, he has studied the isolated papillæ on the tip and sides of the tongue, using a fine brush dipped in tastable solutions. He got no taste sensations from the filiform papillæ, but unmistakable ones generally from the fungiform. Of 125 papillæ examined, 27 responded neither to sour (*Weinsäure* of 2-5 per cent. strength), bitter (quinine, 2 per cent.), nor sweet (sugar, 40 per cent.) Of the remaining 98, 60 responded to sour, bitter and sweet. Of the rest some responded to sour and sweet, but not bitter; some sour and bitter, but not sweet; and still others to sweet, but not sour or bitter; and so on. All the papillæ were sensitive to contact and temperature; the order of sensations being first, contact, at the same instant, or immediately after, cold, then taste. When mixed sugar and quinine were used the sugar was tasted first. Electrical stimulation of single papillæ with a weak induction current called out tactual and temperature sensations and generally also those of taste; most frequently sour, but also sweet and bitter. With the constant current the positive pole was most effective, bringing out a sour taste with a sensation of heat.

The negative pole excited chiefly sweet and bitter sensations, with that of heat, and sometimes at the same time that of cold. Weak currents brought out only such taste sensations as were to be gotten in the ordinary way. The author considers that these results are only to be explained by the presence of special end-organs differently distributed to the different papillæ. This brings the sense of taste into line under the general law of the specific energy of nerves.

In the spring of 1885 Goldscheider and Schmidt made experiments on the sense of taste, but being prevented from completing them made no announcement of their results till moved to do so by the appearance of Oehrwall's work. Their experiments were made in much the same way as his and though less extended lead to similar results and have a corroborative value. Their results are briefly set forth in the *Centralbl. f. Physiol.* Bd. IV, S. 10—12, April, 1890. They found evidence, among other things, for a fatigue of the taste organs (a point not recorded by Oehrwall), as follows: after several applications of quinine to a circumvallate papilla, the bitter taste failed though the papilla responded to sweet; after the use of acetic acid the taste was equally dulled for all four stimuli. In many subjects the only taste sensation excited on the hard and soft palates, especially near the middle line, was that of sweet.

The mysterious case of Caspar Hauser never came to trial, but the Polish newspapers have this spring contained an account of the trial and acquittal of a Polish nobleman, Count Zoronboff, who was charged with sequestering four children and rearing them as animals. It is said that the children were purchased of their poor parents. It would appear, if the meagre accounts at hand are reliable, that they came from four different families, had been dowered for life by the count, had been confined each in a large well lighted and heated and ventilated room, well fed, and occasionally washed by a deaf mute; that they were unclad, never punished or restrained in any act; that two of the children have been confined thus three, one four, and one four and a half years. The defense of the count was that he was conducting a scientific experiment to learn what were the natural instincts and the intuitions really innate in the human species. The count was acquitted. The age of the children is not reported. They did not speak, and made barking, growling noises, and precipitated themselves upon their food like animals. (See Emile Cere, *Revue Internationale de l'Enseignement des Sourds-Muets*, Mars, 1890.)

The following experience, related at first hand in a private letter to the editor, lacks the objective character of a full hallucination, but may perhaps be an interesting intermediate between ordinary experience and those rarer cases aimed at by the Census of Hallucinations of which Prof. James has charge for this country.

"From a youth up I have been subject to impressions more or less distinct and vivid, which seemed to come to me as if from some influence outside of myself. Most generally these impressions would come in a form of words as if a voice spoke them to me. But I have never once thought I had heard an *actual voice*. However vivid and distinct the impression of an utterance of words might be, it was always an inward voice, heard only in the mind.

"The most remarkable instance of the kind I ever experienced took place quite a number of years ago. But the whole incident was so peculiar that every incident of it is just as distinct in my mind as if it were only yesterday.

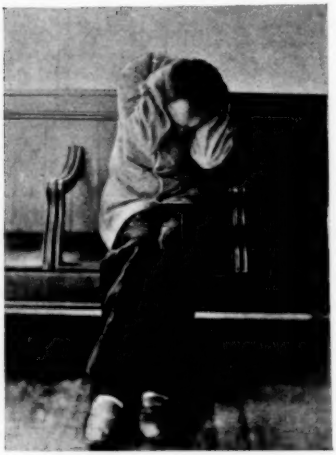
"I was going away from home to be gone two or three days, and it was very desirable that I should see a certain man before I went. But my time was limited, as my business had detained me so late in the

forenoon that it would only be possible for me to take the one o'clock train if I used all diligence in getting ready. So it was out of the question for me to think of calling at his house to see him. In the meantime, while I was shaving myself at the mirror in the back part of the kitchen, and inwardly fretting to myself that I must go away without seeing him, these words were distinctly spoken to my mind, 'You will have a chance to see Brother M. before you go, after all.' I smiled to myself, for the impression could not have been any more vivid that something outside of myself had addressed those words to me, if the same words had actually been spoken to me by some person in the room with me. It was also quite improbable that I should see him at that hour as he was generally quite prompt at his dinner, and it was then a full half hour past his time. While these things were revolving in my mind, the words came to me: 'If you will go to the door you will see him.' But the whole thing seemed so curious as well as incredible that I did not at once go to the door; and in a moment more the words came: 'Be quick! or you will miss him.' Of course I delayed no longer but started for the door, and, as I opened it, Brother M. was at that instant passing the front gate. He had been detained at his office and was going home to a late dinner. Such are briefly the facts."

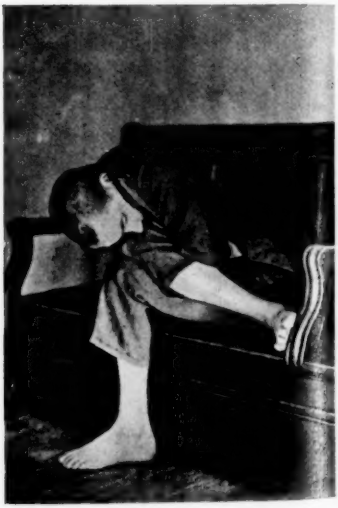
W. W. C.

CASE. I.
Melancholia with Stupor.

CASE II.
Melancholia with Stupor.



CASE III.
Chronic Dementia.



CASE IV.
Chronic Dementia.